

BUILD YOUR OWN

16 bit, 64 RAM colour computer

Standard features –

- High speed 24K byte extended basic interpreter
- Powerful TMS9995 16 bit microcprocessor
- 48 bit floating point gives 11 digit accuracy
- High resolution (256 x 192) colour graphics
- Screen memory does not use up user memory space
- 16 colours available on the screen together in graphic mode
- Fast line drawing and point plotting basic commands
- High speed colour shape manipulation from basic
- Full textual error messages
- String and Array size limited only by memory size
- Real time clock included in basic
- Interval timing with 10mS resolution via TIC function
- Named load and save of basic or machine code programs
- Auto-run available for any program
- Powerful machine code monitor
- Assembler and Disassembler included as standard
- Auto line numbering facility
- Full renumber command
- Simple but powerful line editor
- Buffered i/o allows you to continue executing the program while still printing
- Flexible CALL statement allows linkage to machine code routines with up to 12 parameters
- Basic programs may contain spaces between key words to make programs readable without using more memory
- Over 34K bytes available for basic programs
- Extended basic includes IF-THEN-ELSE
- Supports up to 16 output devices: Screen and cassette interfaces included as standard
- Supports bit manipulation of variables from basic
- Error trapping to a basic routine included
- Basic supports Hexadecimal numbers
- Separate 16K video RAM for graphics

With this powerful machine (featured in Electronics Today International as a constructional project) you have access to highly advanced systems and software developed specially by MPE Ltd for the CORTEX. For business, education, R & D – or simply increasing your knowledge and understanding of computers – it beats comparably priced off-the-shelf machines hands down!

STATEMENTS	PRINT	TIME	RENUM	MAG	MWD	1	()	INT	POS	= =
IF	1	WAIT	BOOT	TOF	BASE	@	ii	LOG	COL	=
ELSE	?	SAVE	GRAPH	TON	COMMANDS	#	FILLIATIONS	SQR	MOD	>
ON	•	LOAD	TEXT	DIM	RUN		FUNCTIONS	SYS	RND	>=
GOTO	1 UNIT	MOTOR	PLOT	LET	SIZE	1	FNA-FNZ	TIC	KEY	<
GOSUB	BAUD	ESCAPE	UNPLOT	DEF	CONT	2	ABS	SGN	OPERATORS	<=
POP	CALL	NOESC	COLOUR	NEW	MON	0/2	ADR	BIT		<>
REM	DATA	RANDOM	CHAR	END		\$	ASC	CRB	OR	_
FOR	READ	ENTER	SPRITE	BIT	DELIMITERS	2.	ATN	CRF	LOR	+
NEXT	RESTOR	LIST	SHAPE	CRB	TO	*	SIN	MEM	AND	1
ERROR	RETURN		SPUT	CRF	TAB	1	COS	MWD	LAND	
INPUT	STOP	NUMBER	SGET	MEM	STEP	0	EXP	LEN	NOT	Λ
	0.0.				THEN	α	FRA	MCH	LNOT	

Self assembly kit

£295

Ready built £395

All prices + VAT Carriage paid

Optional extras

RS232C interface kit Floppy disc interface Pair of 51/2" disc drives and hardware kit £9.20 £65.50

Ready built

CORTEX B – Basic machine + RS232C £410.00 CORTEX C – as above + disc drives £895.00

Full assembly instructions and 216 page user's manual.

£365.00

POWERTRAN cybernetics

Portway Industrial Estate, Andover SP10 3NM. Tel: 0264 64455

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Computing Today is constantly on the look-out for well written articles and programs. If you think that your efforts meet our standards, please feel free to submit your work to us for consideration.

All material should be typed. Any programs submitted must be listed (cassette tapes and discs will not be accepted) and should be accepted) and should be accepted.

not be accepted) and should be accompanied by sufficient documentation to enable their implementation. Please enclose an SAE if you want your manuscript returned, all submissions will be acknowledg-ed. Any published work will be paid for.

All work for consideration should be sent to the Editor at our Charing Cross Road address.

CONTENTS

VOL 5 NO 7 SEPTEMBER 1983

EDITORIAL & ADVERTISEMENT OFFICE 145 Charing Cross Road, London WC2H 0EE. Telephone 01-437 1002-7. Telex 8811896.

CONSUMER NEWS4

Lots of goodies for the home computer

BUSINESS NEWS 8

New products for the commercial micro

SOFT WARES14

Get up to date with new commercial



FELIX KNOWLEDGE SHOPS18

Thinking about a new job? Find out what you might be best at by visiting FELIX Knowledge Shops.

LANGUAGES IN USE 21

Train yourself in the use of languages with this part of our languages series.



PROBLEM PAGE28

Having problems? Solve them on your ZX Spectrum.

SOFTWARE PROTECTION 31

Software piracy is an increasing problem for commercial producers. We look at the situation and some of the ways of trying to overcome the problems

DISCUSSING THE TORCH 41

We review the TORCH Disc Pack and see what it can do for your BBC Micro.

BACKGAMMON.....48

Play Backgammon on your ZX81, but don't try to cheat!

CHARACTER GENERATOR57

Define your own characters, fictitious or otherwise, on your Dragon 32.

PROCopinion62

Our new Acting Editor has been out and about and chats about this and



THE TANDY HAT-TRICK65

Three new Tandy machines have come to light and we take a look at what they

Readers air their views in public.

CLUB CALL78

A look at some of the user groups

Next Month's Com	pu	ıt	iı	10	1	T	0	d	c	17	7		.17
Planetfall													
Froglet													
Computing Today	B	00	ol		S	e	r	7	ic	:6	•		.55
Computamart													.74
Advertiser's Index													.77
Classified													.80
The Valley													.82

CONSUMER NEWS

GETTING BOARD WITH

U-Microcomputers has released four new Applebus cards: a buffered (16K) printer interface U-PRINT16, a speech synthesis board U-TALK, a disc controller U-4DISC and U-CENT, a low-cost Centronics parallel interface.

U-PRINT 16 provides parallel or serial interfacing, has a 16K buffer so that the computer is quickly freed up and can also print graphics directly to the Epson and Apple dot matrix printers.

The U-TALK is a versatile speech synthesis card using National Semiconductor's DIGITALKER speech set. The U-4DISC is a unique Apple compatible disc controller card that allows up to four drives to be attached rather than the usual two. The U-CENT is a no-frills, low-cost parallel (Centronics) printer interface; it comes complete with cable and allows eight-bit data transmission, so users can generate their own graphics dump software.

The prices are: U-PRINT16, £130, U-TALK, £95, U-4DISC, £85, U-CENT, £69. For more details contact U-Microcomputers Limited, Winstanley Industrial Estate, Long Lane, Warrington, Cheshire or phone 0925-54117.

FOR WHOM THE MICRO TOLLS...▼

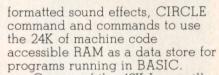
Tollgate Computers announce the availability of the ATR 8000, a combined CP/M Maker and high performance flexible Disc Operating System for microcomputers. The ATR 8000 is

specifically aimed at the Atari 400/800 user who can now use their micro as an improved business machine supporting the popular CP/M operating system. The ATR 8000 can also serve as a flexible peripheral interface to almost any microcomputer system with an RS232 port. For the Atari user, the enhancements provided are double density Atari DOS increased storage capacity, CP/M operating system and an RS232 and Centronics interface. To the non-Atari user, the ATR 8000 allows the conversion of almost any microcomputer or terminal into a CP/M machine at an affordable

The pricing is as follows: ATR 8000 (with 16K RAM), £399; OS/A + (version 4), £49; CP/M Upgrade Kit (including 64K RAM), £199; 51/4" Disc Drive Cable (four drives), £24; 51/4" Disc Drive Cable (two drives), £19; and Printer Cable (serial or parallel), £24. If you would like more information please contact Tollgate Computers Limited, 35 Claydown Way, Luton, Bedfordshire LU1 4DU or phone 0582-32752

FAT CAT

The new 96K version of the Lynx microcomputer appeared in June and is available from retailers for £299 including VAT. The expanded RAM of the 96K Lynx provides 37.5K directly accessible to BASIC in high resolution full colour, with up to 24K more available to programs using machine code. At 20K, the ROM is 4K larger than that of the 48K Lynx; additional ROM features include drivers for both parallel and serial printers, a range of pre-



Owners of the 48K Lynx will be able to have their machines upgraded to full 96K specification through their Lynx dealers who will arrange for the machines to be returned to Camputers for upgrading. The price of the upgrade will be £89.95 including

GETTING STARTED

Commodore have launched their biggest ever promotion featuring the VIC-20. Special VIC-20 boxed sets have been made available in retail outlets and selected Commodore dealerships. Designed particularly for the first time buyer of a home computer, for just £139.99 including VAT, the limited edition packs contain a VIC-20, a cassette deck, Introduction to BASIC Part 1, and four cassette games: Blitz, Hoppit, Race and Type-a-Tune. The current retail price if all the items were sold separately would be £249.99.

GETTING IN PRINT

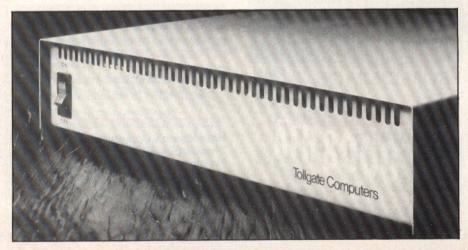
If you don't have access to a printer and you own a BBC Micro you may find that some of your troubles are over. BEEBPRINT will despatch, by return of post, a high quality printed listing from 1200 baud cassettes. All material will be treated in the strictest confidence and tapes returned with the listinas.

The costs involved are: program listing (maximum block count — &20), £1.95; excess charge for programs over &20 blocks, 20p per nine blocks; extra programs (on same tape), £1.00; extra programs (on separate tape), £1.50; 300 baud tapes, 50% extra; high resolution screen dump (needs line added to program), 50p. All prices include postage and packing. Tapes recorded with an 0.1 OS should use the Cassette Bug-fix recommended by Acorn.

For more details on this service why not write to BEEBPRINT, 19 Orchard Way Hurstpierpoint, West Sussex BN6 9UB or phone 0273-833397.

BILINGUAL BEEB

JWB-FORTH V2 is a FORTH language ROM which simply plugs into a spare location in the BBC Micro. It will work with any current operating system and is fully compatible with disc and net



use as well as cassette. It allows full use of all graphics modes, whereas no cassette version does this; all MOS calls are supplied and a text and string editor are included. JWB-FORTH V2 is being used by educational establishments, hospitals, the Ministry of Defence and the BBC as well as by many individuals. The program is fully supported and extensions include full floating point representations and graphics extension.

The program ROM and documentation costs £34.72 excluding VAT and a manual entitled Welcome FORTH costs £6.75 exempt of VAT. Both are available only from HCCS Associates, 533 Durham Road, Low Fell, Gateshead, Tyne and Wear NE9 5EY or phone 0632-821924.

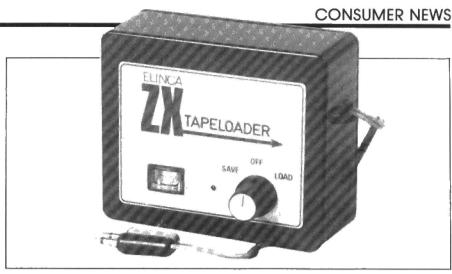
GETTING LOADED

Elinca Products have announced the introduction of a new tape loader for use with the ZX81. The ZX tape loader has been developed to solve problems of computer LOADing and SAVEing, particularly when using a conventional tape recorder. The ZX tape loader filters and stabilises signals in both directions. providing a constant signal perfectly matched to the computer; A major problem encountered when using a standard tape recorder for loading, due to lack of volume measurement and control when the recorder is switched to 'play', is eliminated with the ZX tape loader, which incorporates an audio output indicator and signal amplifier to enable the correct computer input signal to be used.

The new unit also filters out any unwanted signals and hum from the tape recorder. Plugging and unplugging of leads from input and output sockets, when changing from LOAD to SAVE is also not necessary with the ZX tape loader which has a built-in three-way switch, SAVE, OFF and LOAD. The ZX tape loader retails at £14.99 and details can be obtained from any major stockist or direct from the manufacturers, Elinca Products Limited, Lyon Works, Capel Street, Sheffield S6 2NL or phone 0742-339774.

BRIEFING

Diamond Stylus have produced Screenwipes which as well as being suitable for cleaning TV/monitor screens, also ideal for removing dirt and marks from keyboards, computer and printer cabinets, clear equipment covers,



telephones, storage equipment etc. Screenwipes not only clean, but effectively remove and inhibit static from the treated surfaces and finally freshen, by means of a slightly perfumed additive. The retail price including VAT of a 'pull-out' can of 50 wipes is £2.42, and we can testify to the fact that they work - the micros in our office have a much improved appearance! For more information contact The Diamond Stylus PLC. Colwyn Bay, North Wales LL28 5HD or 'phone 0492-40202

If you're not doing anything on Friday 16 September (9.30 am to 8.00 pm) or on Saturday 17 September (9.30 am to 5.00 pm) then why not go along to the Sutton Library Computer Fair which is to be held in the Central Library, St Nicholas Way, Sutton, Surrey SM1 1EA. The last fair was a great success and there will be a wide variety of exhibitors there including the Association of London Computer Clubs.

The Juki 6100 is a low-cost 18cps daisywheel printer designed for word processing use with personal and small business micros alike. The Juki 6100 is a fullfeatured daisywheel emulating Diablo 630 protocol and is fully compatible for use with Wordstar. It has a wide variety of features and a Centronics compatible interface is provided as standard with an RS232 serial and current loop interface as an optional. Paper handling is either by friction feed or optional tractor feed. Available at £399 excluding VAT, further details are available from Micro Peripherals Limited, 69 The Street, Basing, Basingstoke,

Hampshire or phone 0256-3232.

Working with Computers is a new booklet from the Royal National Institute for the Blind, which shows blind people at work at every level of data processing. Sixteen pages of photographs and text describe special equipment including terminals with speech or braille output and conversion of

print into tactile form. Such equipment is financed by the Manpower Services Commission and does not involve employers in extra expense when employing visually handicapped staff. The booklet also demonstrates how blind programmers write flow charts and structure diagrams and describes the training given by the RNIB. The booklet is available free from RNIB, 244 Great Portland Street, London WIN 6AA. (Question - why are none of the

pages in Braille?)

Sending floppy discs by mail can be risky business; physical pressure, overheating or static charges may damage or destroy data stored on the disc. Anti-static floppy disc envelopes recently introduced by Willis Computer Supplies offer protection in a number of ways. A solid hard cover prevents twisting or folding; the envelope lining is an elastic foam material which both absorbs physical pressure from the outside and is permanently anti-static so that conductive charges cannot build up. The new envelopes are self-sealing and are available for 5¼ " and 8" discs. There are two types, to contain either five or 10 of either size of disc. For more information contact **Willis**

Computer Supplies Limited, PO Box IO, South Mill Road, Bishop's Stortford, Hertfordshire.

ER, SORRY

I have to admit it — I do make mistakes! My apologies must go to two companies (and all readers) for an error in the Supplier information given with the FX-20 16-bit micro survey in the July issue of Computing Today. In the issue I stated that the supplier of the FX-20 was Future Technology Systems of Ayrshire. This is incorrect and should have read Future Computers Limited, PO Box 306, Purley, Surrey.

My thanks to those readers

who phoned in.



Software News



TRS 80-GENIE SOFTWARE

from the professionals

EVERY FEW YEARS A UNIQUE PROGRAM ARRIVES

...SO PRACTICAL...SO USEFUL IT BECOMES HERALDED BY COMPUTER OWNERS INTERNATIONALLY AS A TRUE CLASSIC...AN INDUSTRY STANDARD...HIGHLY ACCLAIMED BY EVERY MAJOR TRS-80 PUBLICATION. YOU'VE SEEN IT WITH ONLY A HANDFUL OF TRS-80 PROGRAMS...NOW EXPERIENCE A LEGEND WITH THE NEW...

VERSION 3.0

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MANIPULATE DISK SECTORS, MEMORY AND FILES • COPY FILES FROM AND TO NON-COMPATIBLE DOS'S • ZAP A DIRECTORY • ZAP A SECTOR • COPY A SECTOR AND COMPARE A SECTOR • COMPARE FILES • PURGE A DIRECTORY • DISPLAY DISK MAPS • EXAMINE FILE LOCATIONS • READ AN ALTER DATA ADDRESS MARKS • DOUBLE SIDED DRIVE SUPPORT LDOS. DOSPLUS, AND MULTIDOS • MORE • BOOTS ON MOD I OR MOD III 35, 40, OR 80 TRACKS • SINGLE OR DOUBLE DENSITY • TEST MEMORY • READS ALL CURRENT POPULAR DOS'S TRDOS, LDOS.



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other machines

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The Time Machine
Arrow of Death Part I
Arrow of Death Part II
Escape from Pulsar 7
Circus

Feasibility Experiment

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FAIRYTALE

Basic adventure mainly aimed at the kids but for all the family! Uses a scenario of nursery rhymes and fairytales within which to find the treasures.

WONDERLAND

A follow-up Basic adventure to Fairytale. Fairytales and nursery rhymes again plus cartoon characters.

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V.A.T. included

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- 1) COLOSSAL ADVENTURE: The classic mainframe game "Adventure" with all the original treasures and puzzles + 70 extra rooms.
- "A minor miracle of programming" Popular Computing W. 12 May
- "A few days ago I received Colossal Adventure and I am writing to say that I am delighted with it. I first met Adventure on an Open University summer school and several of us regularly stayed up to 3 and 4 o'clock in the morning playing it. That was 6 years ago, and I've not been able to play it since, so I was immensely pleased to see how like the original yours is.
- Chris Green (customer) April 83
- 2) ADVENTURE QUEST: Through forest, desert, mountains, caves, lake, fire, moorland and swamp on an epic puzzle journey.
- "This is the best adventure yet. I did the H****t in 1 day and p****a in about 31/2 hours." - S Burrows (customer) May 83
- 3) DUNGEON ADVENTURE: "massive adventure with more than 100 puzzles to solve. Rich vein of humour throughout." - The Micro User June 83.

Each adventure needs 32K and costs £9.90 (inclusive). They are very much bigger than normal adventure games that you can buy.

NASCOM PROGS Asteroids

£15/£30 ROM Extension Basic Adds 30 new keywords to BASIC Compression Assembler 2. High speed + source compression

m/c,g £7.90 Galaxy Invaders m/c,q £5.90 Missile Defence m/c,q £7.90 Super Gulp eb.q £4.90 5-games cassette misc £5.90 (FULL RANGE IN NASCOM CATALOGUE)

ALL PRICES INCLUDE P&P AND VAT. ALL programs are in stock and orders will be sent within 2 days of receipt. Please send order or SAE for catalogue, describing your micro, to:

9 COMPUTING LEVEL

Dept C, 229 Hughenden Road, High Wycombe, Bucks HP13 5PG

BBC FORTH

£15

'For your money you get not only a very good implementation of the popular FORTH language but also a 72 page manual ...Once you have got an idea of the fundamentals you should get better value out of this pack than virtually any other program you could buy. In fact, the only reason I can think of for not buying this cassette is that you already have a version of FORTH!" - LASERBUG April 83

"rgFORTH is fast and has a first-class screen editor . . . Overall, a good buy"-Computing Today July 83

rqFORTH costs just £15 (inclusive) and runs on 16K or 32K BBC micros. It:

- needs no added hardware and works with any MOS version;
- works with cassette and disc:
- is FORTH-79 STANDARD and has fig-FORTH facilities;
- provides 260 FORTH words and is infinitely extensible;
- allows full use of the MOS via *MOS, CALL and EMIT;
- permits use of all graphic modes, even 0-2 (just!);
- has an excellent full-screen editor;
- runs faster than BBC BASIC:
- includes a 72 page manual, a 20 page disc supplement and a summary card for quick reference;
- is used by hundreds of people, worldwide.

BBC FORTH TOOLKIT

'Level 9 promise to support rgFORTH and this pack proves it. It provides the source code for all sorts of useful routines and examples of how to program in FORTH. With so much on one cassette it would be good value at twice the price." - LASERBUG April 83

The rqFORTH toolkit costs just £10 (inclusive) and adds the following facilities to FORTH:

- a full assembler, providing machine-code within FORTH;
- turtle graphics, giving you easy-to-use colour graphics;
- decompiler routines, allowing the versatile examination of your compiled FORTH programs;
- the full double-number set (with many extensions):
- an example FORTH program and demonstrations of graphics;
- other useful routines.

THE HR1

THE FINEST PRINTER/TYPEWRITERS MONEY CAN BUY.

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The HR1

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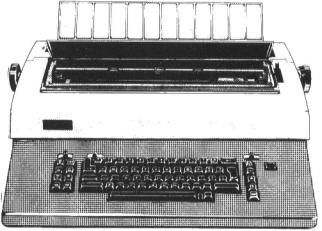
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CENTRONIC – IEEE – RS232 INTERFACES – No external boxes – interchangeable daisywheels – variable pitch – three free daisy wheels – automatic whole line correction – easily copes with standard printed forms – 195,000 characters per ribbon (at least twice the average character length) – standard lift off correctors – a printer/typewriter at the flick of a switch.

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Beware of lightweight, low cost machines - these can never give long term reliable service. THIS MACHINE WILL!! The professional machine

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BUSINESS NEWS



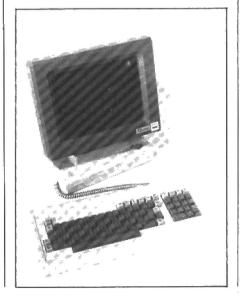
SANYO LAUNCH A

Sanyo have introduced the MBC4050, a high capacity 16-bit 8086-based unit with an optional 8087 numeric data processor at a price of £2450 excluding VAT. This desktop micro offers from 132 to 512K RAM and 6K ROM (4K monitor and 2K character generator). The detachable keyboard features 15 programmable function keys and five cursor control keys, a built-in palm rest and deep-dished keys. The MCB4050's 12" non-glare screen displays 256 different character (8 by 12 matrix) on an 80 characters by 25 lines format. Two 514" double-sided,

Two 5% " double-sided, double-density, double-track slim type disc drives are included giving 1.2 Mb capacity. The microruns under CP/M 86 and supports S BASIC 86, BASIC 86, ASM 86, DDT 86, ED and LOAD 86 which are included. Interfaces include an RS232C port and a Centronics type parallel printer interface. For more information, please contact Sanyo Marubeni (UK) Ltd, 8 Greycaine Road, Greycaine Estate, Watford, Hertfordshire WD2 4QU.

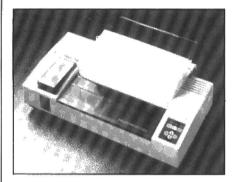
WATCH IT

Qume's latest product is the Qume QVT-102 CRT Terminal. Some features of the terminal include simple menu selection, non-glare screen which tilts and swivels, low detached keyboard, Line Block, Page Block and Unprotected Block page modes, four separate programmable function keys, line



drawing, graphics characters, 9 by 12 character cell resolution, 24 lines by 80 characters plus a 25th status/menu set-up line, screensaver time-out, self-test, switching power supply and RS232C interface plus current loop, with DTR and X-ON and X-OFF protocols.

Access Data Communications, London's main Quine distributor, offer on-site service contracts or return-to-base repairs for all products they supply. The Quine QVT-102 is being offered at a price of £569 or £512 cwo. For further information please contact Access Data Communications Limited, Unit 17, Eskdale Road, Uxbridge Industrial Estate, Uxbridge, Middlesex UB8 2RT or phone 0895-59781.



PLOTTING TOGETHER A

Environmental Equipments have introduced their new A3 size Plotwriter into its Watanabe range of digital multi-pen XY plotters. The Plotwriter is a drum plotter with a built-in print facility compact in size, lightweight and designed for desktop use. With four pens which can be automatically exchanged to provide colourful graphs and drawings, the Plotwriter can be switched easily from a graphic to a print mode using input signals and will print rapidly at a speed of seven characters a second in European, Greek and Katakana type faces.

The piotting speed is 200 mm per second; the Plotwriter can draw straight lines, broken or unbroken circles and curves and will rotate or italicise type characters to 0.1 dégree, Graphics or bar charts can be drawn with solid colours or hatching - to a choice of angles and line spacing. Three types of intertace can be selected - RS232C, GP-IB (IEEE) or eight-bit parallel. At a price of £1531, plus interface, you can get more information from Environmental Equipments (Northern) Limited, Environ House,

Welsh Row, Nantwich, Cheshire CW5 5ES (phone 0270-625115).

IBM DRIVES ONWARDS

The new Europa System G101 Display Multiplexer will drive up to five colour displays from the direct output socket of the IBM Personal Computer, which makes it possible to show the computer colour display to a large gathering for demonstrations, teaching and marketing purposes. Any display may be used if it is suitable for connecting to the computer direct drive colour output socket.

The Display Multiplexer is transparent to all alpha/numeric and graphics signals and leatures fully buffered line drivers, high noise immunity CMOS integrated circuits and an integral stabilised power supply for operation from 120/240 volts 50/60 Hz mains. The standard cables allow each colour display and the computer to be positioned up to five metres from the Display Multiplexer. The cables connect to the front panel with latching 'D' type subminiature connectors.

The price of the Display Multiplexer is £262, the input cable from the PC is £24 and output cables to the displays are £19 each. VAT should be added to the prices. More information can be obtained from Europa Systems Limited, Biggin Hill, Westerham, Kent TN16 3DF, or phone 29-71165.

NEW PRINTER RANGE ▶

A new range of printers designed for use with the ACT Sirius 1 and other microcomputers has been launched by the newly formed Office Products subsidiary of computer group ACT. The Writer range consists of five machines: the ACT WRITERs 10, 12 and 14 matrix printers, the ACT WRITER 20 matrix NLQ printer and the ACT WRITER 30 daisy wheel printer.

Quick delivery should be achieved as all machines will be available ex-stock, the aim being to provide all ACT's 400 dealers with off-the-shelf supplies. The accent will also be on fast field maintenance with 40 engineers on station. The most novel feature of the range is the three-speed facility of the WRITER 20 model which allows the user to select high speeds for data processing or drafting or a near letter quality mode for correspondence.

At the bottom end of the range

is the inexpensive and portable WRITER 10 model, and at the top the WRITER 30 daisy-wheel printer designed for word processing applications, or in business systems where the standard of finished work is paramount. Under the label WRITER 90 is the ACT Automatic Sheet Feeder which allows full page printing and automatic transportation to the output hopper

The WRITER 10 matrix printer for up to four part stationery at 120 characters per second costs £395 plus VAT. The WRITER 12 matrix printer with a 136 column carriage handling up to full width 15° continuous stationery costs £695 plus VAT. WRITER 14 matrix printer, heavy duty for up to five parts stationery at 150 cps costs £1295 plus VAT. WRITER 20 matrix NLQ printer, capable of fast, draft and correspondence speed costs £995 plus VAT. The WRITER 90 automatic single sheet feeder costs £595 plus VAT. For more details please contact Applied Computer Techniques, ACT House, 111 Hagley Road, Edgbaston, Birmingham B16 BLB, phone number 021-454 8585.



BRIEFING

A new low-cost method of safely posting and transporting floppy discs is here: constructed of heavy duty 90 lb board stock, the Sentinel Floppy Disc Shipper envelope for standard and mini discs provides positive resistance to any destructive bending. A smooth polyethylene foam lining eliminates abrasion during transit or loading operations while its antistatic properties prevent dust caused by static. For more details and pricing information please contact Kennet Packaging Limited, Unit 5, Station Road, Thatcham, Newbury or phone 0635-66552.

A new anti-glare treatment kit, Glarego, has been introduced.

Specially developed to provide a lasting non-reflective surface to TV screens, computer terminals and glass-fronted pictures, Glarego is easy to apply; simply prepare the screen with the Cleanscreen provided, then spray on Glarego. The price is £7.95 including VAT but excluding postage. For more details contact **Vision Products**, Unit 10, Wessex Road, Bourne End, Buckinghamshire SL8 5DW or phone 06285-29997.

Datac have introduced a range of 40 column printers which print at high speed on plain paper in red or black. One unit is priced as low as £155 for the end user. These boxed printers are supplied as desktop or panei-mounted versions. Model 510, the desktop unit, measures 197 mm by 240 mm by 74 mm and the panel-mounted model, **520.** measures 150 by 149 by 199 and costs £165. The printers are easy to interface to a micro as serial as well as parallel interface boards are available for control electronics and character generation. A serial dot matrix impact system is used to print 40 characters per line (5 by 7 matrix) on 70 mm wide paper at 1.2 lines per second. Further details are available from Datac Limited, Tudor Road, Altrincham, Cheshire WA14 5TN or phone 061-941 2361.

BFI Electronics, major distributor of Verbatim floppy discs, have announced the availability of two-disc packs for retail outlets; the new twin packs will appeal to small users who at present can only buy discs boxed in 10s. The required average outlay will thus be reduced from over £30 to under £6 per purchase. The discs involved, 5½ " types suitable for most of the personal computer disc drives currently available, are from the Verbatim 'Datalife' Series. More details can be obtained from BFI Electronics Limited, 516 Walton Road, West

Molesey, Surrey KT8 OQF, or phone 01-941 4066.

The book Computer Insecurity is by Adrian R. D. Norman. The author has tried to open the eyes of his readers to the risks associated with computer systems and to this end has brought together a compendium of other people's mistakes. Over 100 crimes, errors and disasters involving computer systems are listed. This book is directed at those who must now or expect later to have to make decisions or advise decision makers about computer security. The book is published by Chapman & Hall, is hardback,

has 366 pages and costs £14.95. The ISBN is 0 412 22310 4.

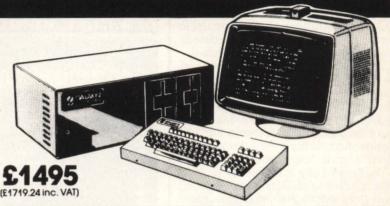


Value - MicroValue - Micro

COMPUTERS Gemini Galaxy 2

"I would place the Galaxy at the top of my list" (Computing Today, April 1983)

- **★Twin Z80A Processors ★CP/M2.2** Operating System
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Total support for Gemini & na/com Products

Based around the successful Nascom 2 computer, this new system can be built up into a complete disk based system. Supplied built and tested complete with PSU, Nas-Sys 3 and Nas-Gra

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Nascom owners can now have a professional 80x25 Video display by using the Gemini G812 Intelligent Video Card with on-board Z80A. This card does not occupy system memory space and provides over 50 user controllable functions including prog character set, fully compatible with Gemini G805 and G815/809 Disk Systems. Software supplied on Gemini system disks. Built and tested.

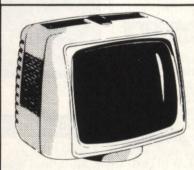
The **Microvector 256A** is a high performance graphics display interface on an 80-BUS and NASBUS compatible card. Various graphic primitives such as vector and character generation are executed in hardware by a Thompson EF9356
Graphic Display Processor. Plotting rates are typically
1 million pixels per second giving full animation capability.
Various vector and character types can be selected. Characters can be scaled to give 256 different sizes. MV 256A Suitable for TV use (PAL-UHF) £199.00 + VAT MV 256B Suitable for TV or RGB monitor £220.00 + VAT





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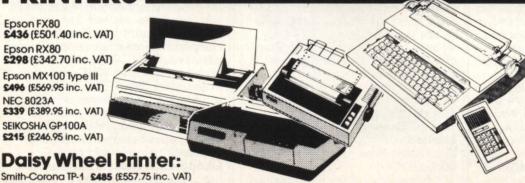
PRINTERS

£436 (£501.40 inc. VAT) Epson RX80 £298 (£342.70 inc. VAT)

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Complete with RS 232 interface and numeric key pad. This module enables the Praxis 41 to be used as:

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Leeds Computer Centre, 60/62 Merrion Centre. Tel: (0532) 458877

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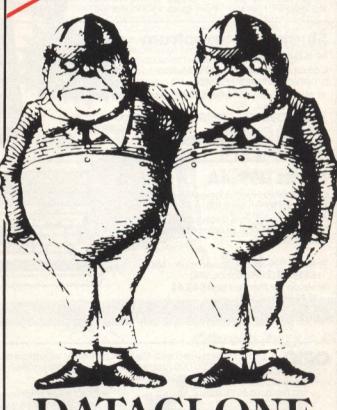
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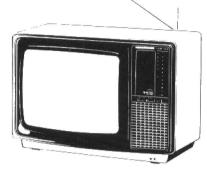


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PLEASE NOTE: Planetoids and certain other games may still require the use of some keyboard commands

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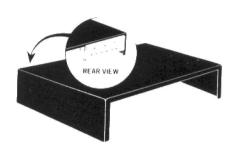
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You'll have 16 colours available (8 full
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graphics with all the outline and picture
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Quite simply, Moreable!

You will be able to use the 128 pre-programmed graphics plus 128 more that you can create yourself, all as foulding blocks for screen displays, with full movement, change shape and polour effects.

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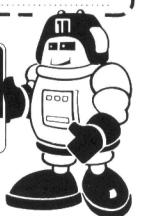
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Data compression is extensively used; the best example is that a 60-character entry selected from the user-defined dictionary can be stored with only one byte; 18 data dictionaries of 255 entries can be used per data base and 20 data bases are available per system.

Rescue is claimed to provide many features and facilities normally only available on mainframe systems. At a price of £295 for the complete system, with a demonstration system costing £35, you can get more details from Microcomputer Business Systems (UK) Ltd, 5 Charterhouse Buildings, 27A Goswell Road, London EC1M 7AN, or phone 01-253 3998.

THE ANSWER LIES IN THE SOIL

Cambridge Applied Technology has recently developed two revolutionary aids for the amateur gardener for use in the comfort of his own home. Available for the BBC Micro Model B, the programs are Greenfinger:Garden plant selector and Garden layout planner.

The plant selector is a program for automatically selecting the plants which will thrive best in a given location within a garden. The computer asks the gardener about the type of soil, available sunlight and moisture and searches its memory for plants which best suit the conditions within a given range of height. The system gives rapid access to over 400 plants.

With the layout planner, the user can tell the computer about the existing or planned sizes and positions of buildings, walls, greenhouses, paths, patios, borders, beds, trees and shrubs. The computer asks where the sun is at noon and amazingly plots a fully-scaled plan view on the

At a price of £12.95 each, you can afford to dig into your pockets and completely redesign your garden. For more details write to Cambridge Applied Technology,

51 Hinton Road, Fulbourn, Cambridge CB1 5DZ or phone 0223-880958.



USEFUL EDITOR

A new, moderately priced (£60 plus VAT), text editor has been released by Lutterworth Software for the Apple II. It is intended for users such as magazine editors, who need to produce short length lines in several columns, hence the name: COLTEXT. The screen shows all text in its output format. with single-key centreing and right-left justification immediately displayed. The same text can be outputted in any number of columns, all without reverse line feed. Lutterworth Software, who specialise in one-off turnkey systems for a wide range of micros, will supply a free sample and manual to enquirers; write to 6 Cromwell Close, Walcote, Lutterworth, LE17 4JJ.

SERIOUS STUFF

Ramtop Software, a new serious software company, have announced their first three business tapes for the 48K ZX Spectrum. The Purchase Ledger, Sales Ledger and Sales Journal comprise a complete book-keeping system; it is a one-entry system based on the Simplex book-keeping system, which makes it extremely easy to use. It is intended for businessmen with little or no knowledge of book-keeping who may never have seen a computer.

The tapes sell at £24.95 each (£60.00 for all three tapes) and this means that small businesses can equip themselves with the 48K ZX Spectrum, ZX Printer and software for under £300. A manual is provided which explains the system and how to use it. Ramtop are also producing a number of educational tapes for the Youth Training Scheme and schools and

colleges.

Customer advice and help will be provided at the end of a telephone if needed, and demonstrations will be arranged locally. For sales enquiries please contact Ramtop Software on 0744-59883 (0928-701428 after 5.00 pm and weekends). Dealer enquiries are welcome and should be addressed to Ramtop Software, 12 Milnthorpe Road, Burtonwood, Near Warrington, Choshire WAS 4PN

PINBALL WIZARD

The Pinball Construction Set builds video pinball games for your Apple II personal computer, although it is claimed as much

more than just another game utility or development tool. To let you touch your Pinball Construction Set, a video 'hand' is included which you can control with your joystick; by moving the joystick lever you propel the hand on the screen, and you can make the hand grasp or select whatever it is touching, enabling you to build your pinball machine from pieces in your parts box. The set contains the pieces and tools to make millions of hi-res video pinball games; no programming or typing is necessary, just take parts from the set and put them on the game board, press a button and play. Available from Pete & Pam Computers, the set costs £27.95.

Three new games written in GraFORTH for the Apple II (48K) with DOS 3.3 are also available from Pete & Pam Computers. They are Zargs, a space fight with four levels of play, Grapple, which isn't as varied as Zargs but has more skill levels, and Spider Raid, in which the player is a mighty spider and has to deal with all sorts of obstacles and enemies in order to get food — the common house fly. All games cost £19.95 plus VAT. For more details of these products, contact Pete & Pam Computers, New Hall Hey Road, Rossendale.

Lancashire BB4 6JG.



MORE FOR LESS

Sinclair Research is cutting the cost of its best-selling 16K ZX Spectrum from £125 to £99.95. Sinclair, which earlier this year announced its one millionth computer sale, has also reduced the larger 48K ZX Spectrum from £175 to £129.95 and will now sell its ZX Printer at £39.95 as against £59.95 previously, all prices including VAT. In an extension of its ZX81 and ZX Spectrum software library, Sinclair Research have launched nine new cassettes. For users with programming interests, the new FORTH program offers a language combining BASIC's



simplicity with the speed of machine code. Games for the ZX Spectrum include Cyrus-IS-Chess, The Spiders, Scrabble and Backgammon. For the ZX81, Sinclair have introduced two new adventure games, Sabotage and City Patrol.

Finally, the growing demand for business software is met by the new Small Business Accounts program (48K ZX Spectrum only) which provides balance sheet and profit and loss information together with VAT returns. Ranging in price from £4.95 to £15.95 including VAT, the cassettes are available by mail order from Sinclair Research, Stanhope Road, Camberley, Surrey (phone 0276-685311) and should also be available in major branches of W.H. Smiths, Boots, Currys, John Lewis Partnership, House of Fraser, John Menzies. Greens and other leading chains and computer stores.

MARRYING MICROS

The UCSD p-system, known for its comprehensiveness, adaptability, portability and renowned Pascal compiler, has now been adapted for use with the Nascom/Gemini family of micros. The system is a set of file-handling, compiling, editing, assembling, linking and executing software in one integrated operating system that is portable between different microcomputers - even those with different microprocessors. It is claimed that it will give Nascom and Gemini computers virtually complete software compatibility with IBM, Sirius, Sage and other computers running the UCSD p-system with a tremendous price saving in hardware.

The latest version has been adapted for the Nascom/Gemini family via the Z80 p-code interpreter and comes with a BIOS and, in the case of a Nascom, a boot ROM, all ready to run. Also provided are utilities to reconligure the drives to read and write discs in virtually any format (including IBM and Sage) via any combination of Nascom and Gemini Controller cards and with a mix of 8" or 5¼" drives.

For more details why not contact Mike York Microcomputer Services, 9 Rosehill Road, London SW 18 2NY, or phone 01-874 6244.

BRIEFING

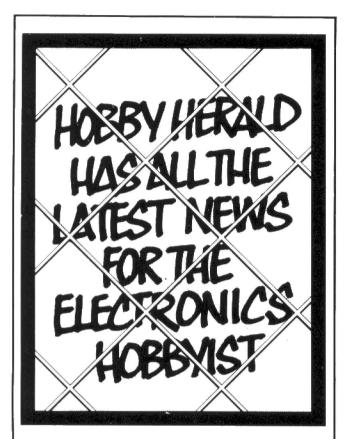
A new mail order software company has been formed which only sells adventure games for almost all personal computers, and to act as a forum for adventurers to swop ideas and hints and also to help people who are stuck (if they can) regardless of where they purchase their program. If you would like a free copy of their catalogue, why not write to Adventure-Zone Software Limited, 10 Ennis Close, Harpenden, Hertfordshire Al.5

The word processing program Simply Write, popular on the PET/CBM, has now been completely rewritten for the Commodore 64. Complete with such facilities as mail-merge and the ability to load and join stored files, Simply Write for 64 is a fullfeature word processor suitable both for business letters and for long essays and reports. Simply Write for 64 costs £35 plus VAT on tape and £40 plus VAT on disc and is on sale from dealers or direct from Simple Software Limited, 15 Havelock Road, Brighton, who will be happy to send full details to readers.

Deskmaster 9 RAM Database is the latest in the Deskmaster series of application programs for the portable Epson HX-20. The data base is available in two forms, 16K and 32K, and both versions cost £29.50 plus VAT from **Kuma** Computers Limited, 11 York Road, Maidenhead, Berkshire SL6 ISQ

K-BASE is an information storage and retrieval system specifically developed for users with no previous computing experience. Easy to learn and operate, the program is written in BASIC and can be used without modification on a wide range of microcomputers. K-BASE 83 is available at £340 from Katotek Design Systems Limited, 9 West Way, Oxford OX2 0JB.

Systematics International Microsystems have launched three new business programs for the IBM PC, Sirius 1 and Apple He. The Administrator Program offers both data base and addressing and mailing facilities (£175 pius VAT), the **Systematics Word Processor** is priced at £175 plus VAT and the Systematics Payroll costs £350 plus VAT. For more information contact Systematics International Microsystems Limited, Cleves House, Hamlet Road, Haverhill, Suffolk (phone 0440-61121).



When you need to update yourself with all that is available in the "Do-it-vourself" market, then you need the Hobby Herald.

Packed with product information essential to the electronics enthusiast, this new electronics catalogue lists over 60 exciting products ranging from All Purpose Cutters to Verobloc, the solderless breadboard. All products are available throughout the U.K. from over 200 stockists.

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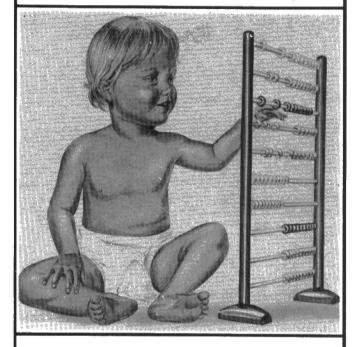




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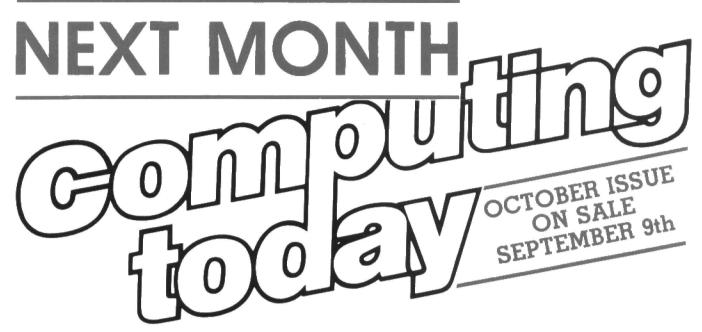
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LOOKING SHARP

Although their marketing successes in other fields of technology have been substantial, the Japanese have never really had more than a foot in the door of the personal computer market. This is surprising, considering the technical excellence of some of their products; the Sharp MZ range is a case in point. Now Sharp claim to have woken up to their failings, and have announced some new machines and a new marketing strategy. We'll be looking at both the home and business machines in an in-depth review next month - find out if the Japanese have got it right at last

A BETTER DOS

Silly old TRSDOS — it only supports the use of 35 tracks per diskette, and doesn't give you the option of declaring drive parameters to rectify the situation. If you're a Tandy/Genie disc drive user and you don't like wasting 12½K per diskette, read next month's Computing Today. The patches are simple to use and written in BASIC, so you don't have to get your hands dirty with machine code.

COMBAT

Are you fed up with those unrealistic space war games that conveniently ignore such real life trivia as inertia, friction, gravity and so on? Here's a two-player game with a difference — when you shoot at your opponent's ship, the missile's trajectory is influenced by the gravity of the planets it passes. The program is written in BASIC, so it's easy to read and easy to convert for other machines. Get to grips with the inverse square law in the October Computing Today.



ADVENTURING WE WILL GO

GIVE THIS TO YOUR REDUCT COON OF Brave editorial staff have risked life and limb descending into dark caverns, eerie tombs and The ording to do t the remotest memory locations of the BBC and ZX Spectrum computers, to bring you software reviews of the more devious adventure games around. If your life seems incomplete unless you're searching the desert wastes for a fishing net, wait until next month, then GET CT and READ CT. (But don't GO NORTH without a space suit!)

Articles described here are in an advanced state of preparation but circumstances may dictate changes to the final contents.

ADDRESS

Peter Green

FELIX KNOWLEDGE SHOPS

A new type of shop opened recently in the heart of London. It sells knowledge. Your editor went along to acquire some.



uch was made of the year of Very little of practical value seemed to some out of it. One of the very few successful independent commercial enterprises to emerge has been Felix Learning Systems Ltd, and the first of their franchised Knowledge Shops opened its doors to the public at the end of May. I went along for a morning to play with the equipment and find out more about the company's objectives.

A Knowledge Shop is a place where anyone may go for a session of computer-aided teaching using interactive video techniques. There are a number of independent workstations in a quiet and pleasant environment, and a number of courses to choose from. I tried out a selection of titles, one from each series — Retail Sales, Saies Representative and Personnel/Administration.

THE SYSTEM

Each workstation contains a rackmounted Apple IIe computer, a Sony U-Matic video recorder, and two Apple disc drives. The student sits in front of a monitor and enters responses on a keyboard. The sound comes via headphones so there are no distractions.

Having selected your course, the floppy disc with the control

program is inserted into one of the drives (we'll get to the other one later) and the U-Matic cassette pushed into the VCR. Once the thing is running, the front panel controls are overridden by the computer — no cheating allowed with sneak rewinding!

My first course was entitled "Can I help you?" and dealt with the problems in various retail departments of a large store. First the VCR ran a short film sequence where actors played out the roles of staff, management and customers who can't find the right paint brush, then the control program turned off the VCR and used the screen to ask questions about the various problem areas you identified and how you would cure them. The course alternates in this way between film sequences and question-and-answer sessions, leading you step by step to an appreciation of the finer points of stock control, customer relations, and staff relations. If it doesn't, of course, then you've found that you aren't suited to this line of work without actually having to go and make a mess of it in real life.

In case you were wondering, I got an 'A'. Perhaps I'm in the wrong line of work.

The second course I tried was "Remember me?" and involved the trials and tribulations of a couple of sales reps making tollow-up calls on their clients. Again, the course consisted of video clips interspersed with questioning, and again I scored fairly highly. Finally came "Just right for the job", which looked at the problems in interviewing candidates for jobs. This turned out to be my weakest area, with a 'B' score. I'll have something to say about the scoring later.

When the session is over, the workstation assesses your performance and plots out graphs on the screen, together with the lettered grades and notes on your rating. This information is also dumped to a printer at the back of the shop, for you to take away and consider; you also get to keep the documentation that came with your course for future

Should you decide to follow up any subject further, you discover that Felix is not just a training centre. The shop has a Viewdata terminal on which you can list any other course relating to your subject running anywhere in the country for up to a year ahead. There is also an extensive range of books. educational video films and microcomputer software packages

Training material need not just be job-related. A pilot scheme currently under evaluation will use interactive techniques to teach drivers the Highway Code.

IMPRESSIONS

Learning about untamiliar subjects (and my abilities to deal with them) in this novel fashion was really quite good fun. Felix have worked hard to ensure that you have the optimum working environment: the surroundings are pleasant, the atmosphere is relaxing and informal, and because it's just you and the computer, you don't feel so worried about making a mistake in front of another person and so your confidence increases. Of course if you should run into problems, there's always a member of staff available to give you a hand. You don't have to be a computer genius to use the system: the keyboard keys are colour-coded for special functions, and the screen usually prompts you for the required reponse — yes/no, agree/disagree, or a multiple choice selection. A pad on the desk explains how to operate the system.

Å nice touch is the choice of actors: they are all professionals from stage and TV, but they're the ones whose names you never remember. This is less distracting than using someone like John Cleese you'd be waiting for him to break

into a silly walk!

However, there are some aspects of the software that I feel could be improved, despite the fact that Felix have spent a great deal of time and money and used educational psychologists, systems designers and all manner of other experts to design the workstations and courses. First, while the software is generally user-friendly, at one point in the 'interview' package the program asked me to type in three things that I thought the interviewer needed to organise prior to the interview. Three areas for text entry appeared on-screen and the cursor jumped to the start of the first. I typed in a vague guess for the first, hit Return, and then ran out of ideas. Hitting Return again for the second and third answers didn't work; the computer was trapped against accepting a null string. Fair enough for me - I just typed in two lines of gibberish to escape to the next question — but a system aimed at Joe Public ought not to pose even the slightest ambiguity about operation

Second, the scoring doesn't seem to be sufficiently detailed in its grading. There's straight three-way split, 0-33%, 34-66%, and 67-100% corresponding to grades C, B, and A. So I got a pretty miserable score for job interviewing, yet I was rewarded with a B grade. The sample printout shown here with zero scores still had a pretty encouraging tone, implying that the student only had to sort out a few problems in his attitudes to become a red-hot salesman. Wouldn't it be more useful to have a 20% increment in scores, with grades A-E, and reports for appalling scores like "You are a twit — go and choose something you are better at"? I can understand Felix not wanting to upset sensitive clients, but it might not be very helpful to raise false hopes in people.

I stress that these are rather minor quibbles compared to the extraordinary potential of the system to provide easy and effective tuition.

IN THE FUTURE

Although it is quite possible for any member of the public to walk in off the street, slap down a sum as low as £30 in anything that vaguely resembles money, and sit down at a console, Felix feel that the bulk of their trade will be with companies whose business requires them to undertake localised staff training on a continuous basis. This will come into its own when the country is covered with a network of franchises. Felix plan to make each franchise a specialist in one particular field, law or accounting

FELIX LEARNING SYSTEMS

BUSINESS SERIES: MARKETING SALES

Towards Bétter Sales

"Just Sign Here" - Closing the Sale

This is to certify that on

successfully completed a section of the Felix interactive training assessment package 'Towards Better Sales'.

You are an over anxious salesman. You are too eager to make a sale and are afraid of failure. You wish to build up a relationship with your customer but worry that the personal questions may spoil such a relationship. You overstress the need to sign, adding extra incentives in order to reassure your customer.

You are familiar with your product and can present it well, however, your nervousness shows itself in flippant remarks to the customer as you gradually become unsure of your ground.

You find it difficult to react to the customer and hope that he will make the first move. Therefore, you are over anxious when he starts to show his doubts and objections. You are too eager to agree with the customer's point of view and find yourself agreeing that your product is indeed too expensive.

You can easily be distracted by this way of thinking and end up arguing with your customer about rates of inflation or other factors which do not directly relate to your product.

If the customer says that he is not ready to buy, you agree to come back at a later date, thus increasing your own sense of failure and confusing the customer. When the customer explains his objection you offer an alternative product immediately. This suggests disinterest in his requirements

An over anxious approach does not necessarily contribute to a rejection. Your enthusiasm for your product can create a very positive reaction from the client. If you have organised your call based on a systematic approach to demonstrating and explaining the positive plus points of your product them you will not be wasting your customer's time. You can be confident that your approach is correct if you ask your customer pertinent questions about his requirements at the beginning of the appoinment rather than immediately presenting your product to him. This will give you both the opportunity to relax and to develop a rapport. Selling is a profession where the consultative approach can be most successful in establishing a long term relationship with a customer. The customer needs to feel that you have his best interests under consideration and that you will spend your time with him exploring the possibilities of finding a suitable solution to his problem.

Fig. 1. This sample printout is the report for a person who scored 0%. Perhaps the comments should be a bit harsher?

for example, and for different franchises to swap their expertise when necessary.

Another type of couse that Felix has planned is more of a company assessment to discover which employees are ripe for promotion and can cope with the responsibilities. A typical test will last for an hour, but instead of being able to answer the questions at your own pace, there is a clock ticking away in the corner of the screen. You are presented with situations that, say, a head of department would need to cope with, and like a pilot in a flight simulator, anything that can go wrong probably will. The snag is that while you get one printout giving an assessment at the end as usual, data about your performance is being stored on the second disc drive for separate processing, the report going to the managing director of your company. Hmmmm — hope ours isn't reading

The final exciting prospect is that Felix will be happy to work with a company to tailor-make a training package. For example, if your company already has a training film, Felix can transfer it onto videotape together with the control information for the Apple, thus providing a custom-designed interactive training course. You can decide whether to keep this material for your own employees or allow Felix to offer it to the public.

CONCLUSION

Felix has a great future ahead of it, since my only criticisms are of points that could be fixed with no great effort, and indeed, the manager told me that the courses are still being developed and are subject to improvement. The company has combined new effective teaching techniques with a system that can bring home to everyone that computers are tools and not just games machines, and I expect to see Knowledge Shops throughout the country in the not-too-distant future.

By the way, does anyone want to buy a paintbrush . . .?

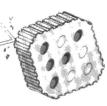
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The letters in correct order.

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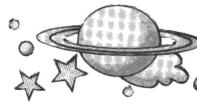
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Count the dots (between 1 and 9) and watch the laser beam bounce the ball up the screen. Build up speed and score lots of points.

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Longman Software The Key to Early Learning

G. Marshall

LANGUAGES IN USE

You can keep on the right tracks with this train simulator which is developed in COMAL and BASIC.

here is something of a shortage of software for simulations. Aside from programs intended purely for educational use in schools and colleges, there is little available for microcomputers. This is a pity because most microcomputers are ideal vehicles for a simulation having, needless to say, the necessary computing power, and also graphics facilities to display the simulation effectively.

APPLICATIONS

Outside the microcomputer field one of the most impressive applications of simulation is in flight simulators. Here computers are used to produce the graphics giving a pilot's view from the cabin of an aircraft. In addition to this, they control the movements of a cabin so that the feeling of movement associated with the manoevres of an aircraft is also simulated.

Simulation can also be used to test the integrity of a structure or the stability of an aerofoil. By solving the complicated sets of equations associated with problems such as these and displaying the results, designs can be tested without the need to build the item. Real-time simulation is a valuable tool for examining situations in the real world. It can be used, for example, to examine the effects on the traffic in a town caused by changing the road layout or how air traffic will be affected by a change in aircraft control procedures.

These are all examples of very sophisticated simulations. When writing a simulation for a micro, at least to begin with, one needs to be rather less ambitious in one's aims than to try to produce a simulation as grand as these. However, with a well-chosen subject a simulation program can

grow to any length.

In this article, a simulation of a train moving round a track is developed. The simulated train moves in real time by accessing the computer's clock. Instructions can be issued interactively to the simulated system, for example to start and stop the train and to switch the points on the track. A

program is first developed in BASIC. The actual development is somewhat contrived, and to demonstrate a more natural development a program is also written in COMAL. The COMAL program uses procedures to good effect and generally displays a much more direct line of development. The resulting program is much easier to understand and, therefore, to extend, adapt and amend.

Besides showing how a simulation program can be written. and displaying something of the relative merits of BASIC and COMAL, the programs that are presented here can be used as the basis of any number of projects. They can be extended in many interesting directions and can also be adapted for other simulations. The programs are written for the PET, but they can be readily adapted to run on any block graphics system. The only PETdependent features in the BASIC

program involve the clock and the screen memory. The COMAL program is written in the version of COMAL 80 that is available for the PET. This version, known as CBM COMAL 80, possesses a version of the GET statement different from that of BASIC. It seems that this GET facility is not available in all the versions of COMAL, and so even the COMAL program has one PET-dependent feature.

DISPLAY DESIGN

The screen is divided into several parts for the display as shown in Fig. 1. The track on which the train is to move is displayed in the bottom part of the screen, while the part above it is split into four parts to display the status of the simulated system and give information about the commands it can accept. These four blocks are labelled 'status', 'command status', 'command summary' and 'error messages'. The status block shows the state of the train/track system by giving the position and speed of the train, and giving the state of the points on the track. The command summary block provides a summary of the commands that can be issued so that they are always available for easy reference. The command status block shows whether the system is ready to accept a command or

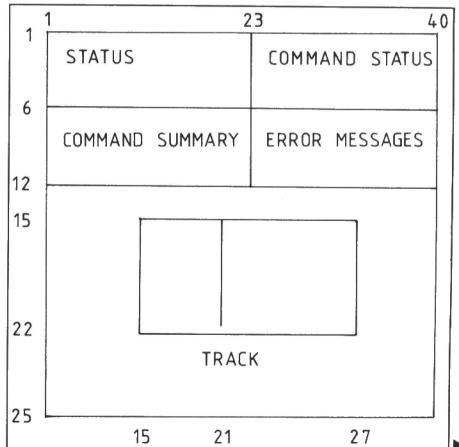


Fig. 1. Design of screen layout.

already dealing with one. The error messages block is to display any error messages resulting from inappropriate commands, such as instructing a train to accelerate when it is at top speed already.

The design chosen for the track itself is shown in Fig. 2. The train is to move clockwise around the track. Consequently the junction on the top line is a converging arrangement which can handle a train approaching on either branch, while the junction on the bottom line requires points to switch the train to either the right- or left-hand branch.

The commands are all given one letter abbreviations so that they can be issued by pressing a single key. The program implements only four commands, although it is straightforward to add more. The commands with their abbreviations and meanings are given in the following table.

Command and Abbreviation	Meaning
Accelerate (A)	Make the train accelerate. When issued to a stationary train, cause it to start.
Decelerate (D)	Make the train decelerate
Halt (H)	Make the train halt
Switch points (P)	Make the points switch over.

There is at least one possible error condition that can result from each command being issued in the wrong circumstances. That associated with acceleration has already been mentioned. Others are that a stationary train cannot decelerate, it is pointless to tell a stationary train to halt, and the points should not be switched while the train is actually on them.

PROGRAM DESIGN

The simulation program, from what we have decided so far, should have the following form:

INITIALISE VARIABLES FOR
TRACK
INITIALISE VARIABLES FOR
TRAIN
INITIALISE VARIABLES FOR
DISPLAY BLOCK
PLOT DISPLAY BLOCKS
PLOT TRACK
PLOT TRAIN
PERFORM SIMULATION

The first six actions are all to do with initialisation, and will be performed only once. They can be carried out in a straightforward way once we decide on the precise form that all the details of the

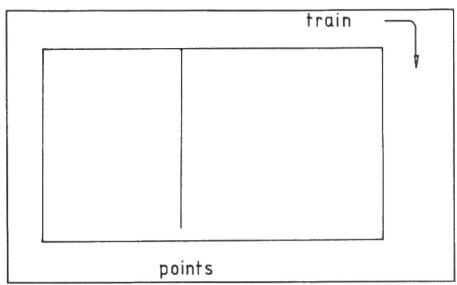


Fig. 2. Design of track.

simulation should take. As regards the final action of performing the simulation, however, there are many matters that must be dealt with. These include moving the train, accepting commands, carrying out the commands and updating the display blocks. These matters can all be handled as shown below:

BEPEAT WHILE TRAIN STATIONARY LOOK FOR COMMAND IF COMMAND GIVEN THEN RESPOND AND UPDATE DISPLAY **ENDWHILE** WHILE TRAIN NOT STATION-ARY REPEAT LOOK FOR COMMAND IF COMMAND GIVEN THEN RESPOND AND UPDATE DISPLAY UNTIL TIME TO MOVE TRAIN MOVE TRAIN ENDWHILE UNTIL END OF SIMULATION

This gives us the basis for the program to create the simulation. But before we can do this, it remains to decide on the matters of detail.

DEALING WITH DETAIL

The details of the simulation are specified in this section, and the names of the variables to be used in the BASIC program are given. In COMAL variables can be given long names and so they should usually be self-explanatory.

The precise layout of the display is also shown in Fig. 1 where the columns and rows occupied by the various items are indicated. The track and train are created using the graphics

characters in Fig. 3. Their codes for use with POKE on the PET are also given. The character with code 254 is used to represent the train. The direction in which the points are switched is indicated as shown in Fig. 4. The track is made up of 47 block graphics characters. Their positions are labelled from 1 to 47 as indicated in Fig. 5. In the

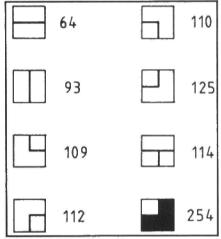


Fig. 3. Block graphics characters used for track and train.

simulation each position on the track corresponds to a single-character position on the screen. By using the 47-element array AD to store the addresses of locations in the screen memory corresponding to each screen position, and the 47-element array PC to hold the codes, for use with POKE, of the characters to be placed in each screen position, the track can be plotted by:

FOR I=1 TO 47: POKE AD(I), PC(I): NEXT I

The position of the train is held in P, and so the train can be plotted by:

POKE AD(P),254

The train moves to the positions on the track in the order indicated by the arrows in Fig. 5. This order can be recorded in a 47-element array N in which N(I) gives the next position after position I. Thus, to give a few examples, N(1) = 2, N(5) = 6 and N(47) = 6. In this way, the next position to be occupied by the train can always be computed by:

P=N (P)

The state of the points is held in PNT, with PNT = 0 representing the points switched to the left and PNT = 1 to the right. The points could be switched over by the commands:

IF PNT=0 THEN PNT=1 IF PNT=1 THEN PNT=0

However, the single simple command:

PNT=1-PNT

has the same effect and is much more compact. Similarly, the next position after the points can be changed by:

IF PNT=0 THEN N(28)=29 IF PNT=1 THEN N(28)=41

or by:

N(28)=29+12*PNT

The train speed is held in SP. A stationary train is represented by SP = 0, and there are four different speeds represented by values of \hat{l} to 4 with SP = 4 representing the top speed. The commands for acceleration and deceleration cause the speed to be increased or decreased by one when that is possible. The halt command causes SP to be set to zero. The speed at which the train moves is simulated by holding the train in a track position for a fixed length of time. These time delays are held in the array TD, so that at speed SP the relevant time delay is held in TD(SP). It is given as a number of 'jiffies' (sixtieths of a second), which is the time unit of the PET's clock.

THE BASIC PROGRAM

The part of the program for the initialisation stages can now be written in a straightforward way. It is lines 10 to 720 in Listing 1.

The simulation part of the program cannot be written easily with reference to the rather natural specification given already, since BASIC does not support repetitions controlled by WHILE and UNTIL. To provide a framework for writing the BASIC program a specification expressed in terms of simple conditions is more appropriate, relating as it does to the IF—THEN statement of BASIC. An appropriate description of the

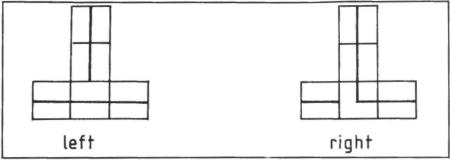


Fig. 4. Representation of points.

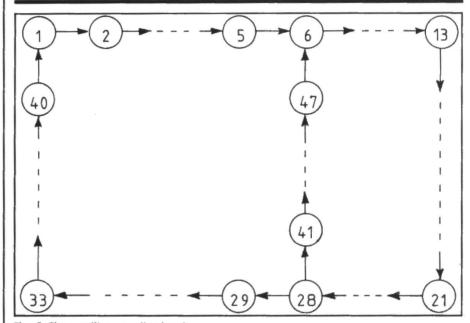


Fig. 5. The positions on the track.

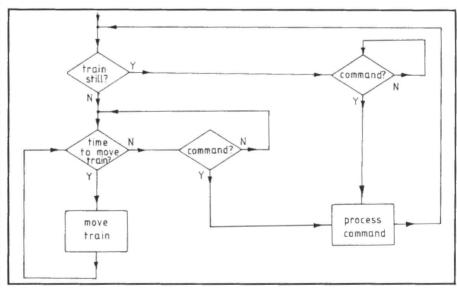


Fig. 6. Flowchart for the BASIC program.

simulation is given by the flowchart of Fig. 6.

The action for processing commands is written as a subroutine since it is much used and is accessed by two different routes. The subroutine must identify which command is issued, test for possible error conditions, take the appropriate action and update the display accordingly. A

flowchart giving the outline of the specification of the routine is given in Fig. 7. By giving only the outline, the selection procedure carried out by the subroutine, to identify the command that is issued, can be clearly displayed. Once a command is identified, the action taken to process the command is fundamentally the same in each case. First a test to

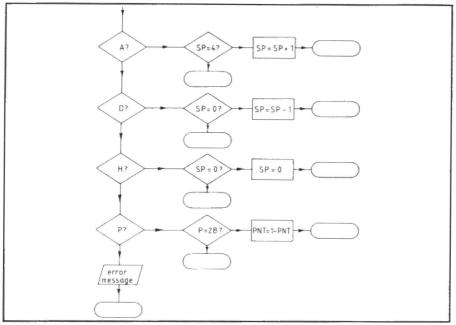


Fig. 7. Flowchart for the command processing subroutine.

see if an error situation results from issuing the command is made. If it does, then an appropriate message is displayed (this step is not shown in the flowchart) before returning to the main program with the command ignored. If no error condition exists, the appropriate change is made in response to the command, the display is updated (again, this step is not shown in the flowchart) and control is returned to the main program.

Lines 1000 to 1240 of the BASIC program in Listing 1 provide the simulation part of the program. The subroutine for processing commands begins at line 2000. It may be worth remarking that this subroutine implements a little command

language.

The following list gives a summary of the variables used in the program and their purposes.

Variable	Purpose
AD	array of addresses in screen
	memory for track display
ER\$	array of error messages
N	array of next-positions on track
P	position of train on track
P\$	points messages
PC	POKE codes for track
PL\$	array of positioning strings
PNT	state of points
SP	speed of train
T	time at start of timing period
TD	array of time delays for
	movement
TI	time on system clock

COMAL

COMAL is chosen here as the language for writing an alternative version of the simulation program because it permits the first description of our simulation to be programmed directly. This is in stark contrast to the way in which another description had to be generated before the BASIC program was written.

The segment of the COMAL program for the simulation is listed below so that it can be compared with the description of the simulation process to show how easily the COMAL program can be generated from the description:

STATIONARY: = THJE END: = FALSE HEPEAT WHILE STATIONARY DO C\$ = GEYS(8) IF C\$ <> CHRS(8) THEN EXEC PROCESS ENDWHILE WHILE NOT STATIONARY DO REPEAT C\$ = GETS(8) IF C\$ <> CHRS(8) THEN EXEC PACCESS UNTIL TIME - T > TD(SP) EXEC MOVETHAIN UNFIL END ENDWHILE UNFIL END Th C\$ f - t

The features of COMAL that make it so easy to translate a program description into a program include the availability of logical variables and the capability to define named procedures. A logical variable can be either true or false. A procedure can be executed in the main program by a statement consisting of EXEC followed by the name of the procedure. In COMAL the equivalent of BASIC's GET is the function GET\$(X). When X is 0 this returns the next ASCII character from the keyboard. If no key is pressed the NULL character (with ASCII code zero) is returned.

The part of the COMAL program for the simulation, including the procedures PROCESS and MOVETRAIN, is listed in Listing 2. The part of the program for the initialisation stages is not listed as it is very similar to the corresponding part of the BASIC program. Where a variable

serves the same purpose in the COMAL program as in the BASIC program it is given the same name. In this way the COMAL program listing maintains a parallel with the BASIC program. This does mean that COMAL is not shown to full advantage, since its long variable names can make programs readable and the purpose of a variable readily apparent. One exception is that the PET's clock is accessed from BASIC by the variable TI, but from COMAL by the variable TIME.

The procedure for processing the commands is written using a CASE statement to determine which command is issued rather than the sequence of IF — THEN statements in the BASIC program. This is because the CASE statement of COMAL permits the use of a character variable as a selector. The use of CASE and IF — THEN — ELSE statements gives a procedure with a single exit point, in contrast to the BASIC subroutine which has numerous exits.

CONCLUSIONS

There is plenty of scope for further developing the programs presented here. One obvious addition would be to include provision for reversing the train. A second is to extend the program to handle more than one train.

The following remarks can be made on the languages used. Before a program can be written for a task, it must be specified in some way. A natural way to specify a task is to give its description in careful English. This article gives one illustration that BASIC is not an entirely suitable language for creating programs from such natural descriptions, whereas COMAL is. BASIC does not possess the programming structures corresponding to the features of a natural description. This makes it necessary to generate a contrived description of the task that is matched to the features that BASIC *does* possess before a directly corresponding BASIC program can be written. In contrast, COMAL has all the necessary programming structures for a natural description to be converted line by line into a COMAL program.

A program developed from a clear and careful description to which it is directly related will be easy to correct, understand and modify. A program that is developed in an indirect way because of the shortcomings of the language it is written in can claim

none of these properties.

```
10 DIM N(47), PC(47), AD(47), TD(4)
                                                                              550 PRINT"[3 CR]POINTS"
                                                                              550 PRINT"[CD][2 CR]COMMAND SUMMARY[7 CR]ERROR MESSAGES"
570 PRINT"[2 CR]START, ACCELERATE (A)
580 PRINT"[2 CR]HALT (H)"
590 PRINT"[2 CR]DECELERATE (D)"
600 PRINT"[2 CR]SWITCH POINTS (P)"
20 DIM ER$(5),PL$(4),P$(1)
30 REM***INITIALISATION OF VARIABLES***
40 REM VARIABLES FOR TRACK
50 FOR I=1 TO 46
60 N(I)=1+1
70 NEXT I
                                                                              610 REM DISPLAY INITIAL STATUS
80 N(40)=1: N(47)=6
                                                                              620 PRINTPL$(0);STR$(SP)
90 PNT=0
                                                                              630 PRINTPL$(1); STR$(P)
                                                                              640 PRINTPLS(2); "IREVI WATTING (OPFI"
650 PRINTPLS(3); PS(PNT)
100 FOR I=2 TO 12
110 PC(I)=64; AD(I)=33341+1
120 J=34-I
                                                                              660 PRINTPLS (4): ERS (0)
130 PC(J)=64:AD(J)=33661+I
                                                                              670 REM PLOT TRACE
140 NEXT I
                                                                              680 FOR 1=1 TO 47
150 PC(6)=114
                                                                              690 POKE AD(I), PC(I)
160 FOR I=1 TO 7
                                                                              700 NEXT 1
                                                                              710 REM PLOT TRAIN
170 J=13+T
                                                                              710 REM PLOT TRAIN
720 POKE AD(P), 254
999 REM *** SIMULATION ***
1000 IF SP<>0 THEN 1100
1010 GET C$: IF C$-** THEN 1010
180 PC(J)=93:AD(J)=33354+40*1
190 K=41-I
200 PC(K)=93:AD(K)=33342+40*I
210 L=48-I
                                                                              1020 GOSUB 2000: REM PROCESS COMMAND
1030 PRINTPES(2);"[REV] WATTING [OFF]"
220 PC(L)=93:AD(L)=33347+40*I
230 NEXT I
240 PC(1)=112: AD(1)=33342
                                                                              1040 GOTO 1000
250 PC(13)=110: AD(13)=33354
260 PC(21)=125: AD(21)=33674
270 PC(33)=109: AD(33)=33662
                                                                              1100 IF T1-T>=TD(SP) THEN 1200
1110 GET C$: IF C$- ""THEN 1100
1120 GOSOB 2000: REM PROCESS COMMAND
280 REM VARIABLES FOR TRAIN
                                                                              1130 PRINTPL$(2); "[REV] WAITING [OFF]"
                                                                              1140 GOTO 1000
1200 POKE AD(P),PC(P)
290 SP=0: P=1
300 TD(1)=100:TD(2)=65:TD(3)=40:TD(4)=25
310 REM MESSAGES
320 ER$(0)="[15 SPC]"
325 ER$(1)="[2 SPC]NOT A COMMAND"
330 ER$(2)="TOP SPEED -NO A"
335 ER$(3)="[2 SPC]HALTED NOW(H)"
                                                                              1210 P=N(P): PRINTPL$(1); STR$(P)
                                                                              1220 POKE AD(P),254
1230 T=T1
                                                                              1240 GOTO 1100
                                                                              1250 END
340 ER$(4)="HALTED NOW-NO D"
345 ER$(5)="TRAIN ON POINTS"
                                                                              2000 PRINTPL$(2);"[REV]PROCESSING[OFF]"
                                                                              2010 PRINTPLS(2); [REV]PI
2010 PRINTPLS(4); ERS(0)
2020 IF CS="A" THEN 2080
2030 IF CS="A" THEN 2120
2040 IF CS="D" THEN 2150
2050 IF CS="P" THEN 2180
345 ER$(5)="TRAIN ON POINTS"

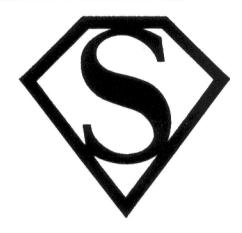
350 P$(0)=" LEFT":P$(1)="RIGHT"

360 REM POSITIONING STRINGS

370 PL$(0)="[HOM][2 CD][18 CR]"

380 PL$(1)="[HOM][3 CD][18 CR][2 SPC][3 CL]"
390 PL$(2)="HOM][3 CD][26 CR]"
395 PL$(3)="(HOM][4 CD][12 CR]"
                                                                              2060 PRINTPL$(4);C$;ER$(1)
                                                                              2070 RETURN
                                                                              2000 IF SP=4 THEN PRINTPL$(4); ER$(2): RETURN 2000 IF SP=0 THEN T=TI
400 PLS(4)="[HOM][8 CD][24 CR]
410 REM *** CREATE DISPLAY ***
420 REM PLOT STATUS BLOCKS
                                                                              2100 SP=SP+1: PRINTPL$(0); STR$(SP)
425 PRINT"[CLS]
                                                                              2110 RETURN
430 FOR I=32768 TO 32807
                                                                              2120 IF SP=0 THEN PRINTPL$(4); ER$(3): RETURN
440 POKE I,160:POKE I+200,160
450 POKE I+440,160
                                                                              2130 SP=0: PRINTPL$(0):STR$(SP)
                                                                              2140 RETURN
460 NEXT I
                                                                              2150 IF SP=0 THEN PRINTPL$(4); ER$(4): RETURN
470 FOR J=1 TO 10
                                                                              2160 SP=SP-1: PRINTPL$(0); STR$(SP)
480 POKE 32768+40*J,160
                                                                              2170 RETURN
490 POKE 32790+40*J,160
                                                                              2180 IF P=28 THEN PRINTPL$(4); ER$(5): RETURN
500 POKE 32807+40*J,160
                                                                              2190 PNT=1-PNT: PRINTPL$(3);P$(PNT)
2200 N(28)=29+12*PNT: PC(28)=64+45*PNT
510 NEXT
520 PRINT"[hom][CD][2 CR]STATUS[16 CR]COMMAND STATUS"
530 PRINT"[3 CR]TRAIN SPEED"
540 PRINT"[3 CR]TRAIN POSITION"
                                                                              2210 POKE AD(28), PC(28)
                                                                              2220 RETURN
                                                                            READY.
                                                                                                                     Listing 1. BASIC program listing.
2000 STATIONARY:=TRUE
                                                                              3120 SP:=SP+1
2010 END:=FALSE
                                                                             3130 PRINT PL$(0); STR$(SP)
2020 REPEAT
                                                                              3140 ENDIF
                                                                              3150 WHEN "H"
2030 WHILE STATIONARY DO
                                                                             3160 IF SP=0 THEN
3170 PRINT PL$(4); ER$(3)
2040 C$:=GET$(0)
2050 IF C$<>CHR$(0) THEN EXEC PROCESS
2060 ENDWHILE
                                                                              3180 ELSE
2070 WHILE NOT STATIONARY DO
                                                                             3190 SP:=0
                                                                              3200 STATIONARY:=TRUE
2080 REPEAT
                                                                              3210 PRINT PL$(0); STR$(P)
2090 C$:=GET$(0)
2100 IF C$<>CHR$(0) THEN EXEC PROCESS
                                                                             3220 ENDIF
                                                                             3230 WHEN "D"
2110 UNTIL TIME-T>TD(SP)
                                                                             3240 IF SP=0 THEN
3250 PRINT PL$(4); ER$(4)
2120 EXEC MOVETRAIN
2130 ENDWHILE
                                                                              3260 ELSE
2140 UNTIL END
2500 PROC MOVETRAIN
2510 POKE AD(P), PC(P)
                                                                             3270 SP:=SP-1
3280 IF SP=0 THEN STATIONARY:=TRUE
                                                                              3290 PRINT PL$(0); STR$(SP)
2520 P:=N(P)
2530 PRINT PL$(1);STR$(P)
                                                                             3300 ENDIF
                                                                              3310 WHEN "P"
2540 POKE AD(P), 254
2550 T:=TIME
                                                                             3320 IF P=28 THEN
2560 ENDPROC
                                                                             3330 PRINT PL$(4); ER$(5)
                                                                             3340 ELSE
3000 PROC PROCESS
3010 PRINT PL$(2); "[REV]PROCESSING[OFF]"
                                                                             3350 PNT:=1-PNT
                                                                             3360 PRINT PL$(3):P$(PNT)
3020 PRINT PL$(4); ER$(0)
3030 CASE C$ OF
3040 WHEN "A"
                                                                             3370 N(28):=29+12*PNT
                                                                             3380 PC(28):=64+45*PNT
3050 IF SP=4 THEN
                                                                             3390 POKE AD(28), PC(28)
3060 PRINT PL$(4); ER$(2)
                                                                             3400 ENDIF
3070 ELSE
                                                                             3410 OTHERWISE
3080 IF SP=0 THEN
                                                                             3420 PRINT PL$(4);C$;ER$(1)
3090 T:=TIME
                                                                             3430 ENDCASE
3100 STATIONARY:=FALSE
                                                                             3440 ENDPROC
3110 ENDIF
                                                                                                                   Listing 2. COMAL program listing.
```

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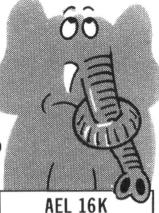
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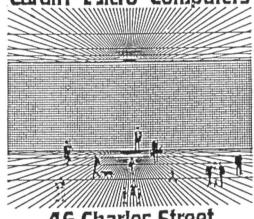
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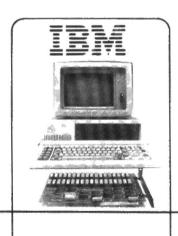
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Don Thomasson

OBLEM PAG

A solution, a problem, and a discussion on the inability of computers to use insight.

n he emphasis on prime numbers last month should have provided a fairly broad clue to the solution of the problem propounded. The members of the club paid up a total of £2088.60, and if the secretary had contributed the extra penny towards his own present the total would have been £2088.61. Even without the hint, experienced problem-solvers would guess that 208861 was the product of two prime numbers, one less than 400 (the subscription plus Ip) and the other greater than 400 (the number of members). The problem then involves discovering the factors (331 and 631).

The program in Listing 1 is convenient for this purpose, but the lengthy data statements are less convenient. If you used the program given last month to create an array full of primes, that can be used in place of the data. No more than the first 180 primes will serve for factorising numbers up to a

million.

The computer can thus be made to do the donkey work, but the method has to be decided first. Nor is the result of factorisation the final answer to the question posed, which asked how much was available to spend on the present. That will be the larger of the two factors, less one. It would have been possible to extend the program to provide that as the result, but the program would then

```
100 CLS
110 DIM M(20)
120 INPUT A
  130 RESTORE
  140 LET X=A
150 LET M=1
160 FOR N=1 TO 79
   170 READ D
1/U MEAD D
180 LET P=X/D
190 IF P<>INT (P) THEN GD TO 240
200 LET M(M)=D
210 LET M=M+1
220 LET X=P
230 GD TD 180
240 NEXT N
230 GD TD 180
240 NEXT N
250 IF X<>1 THEN LET M(M)=X; LET M=M+1
260 PRINT "The factors of ";A;" are;"
270 FDR N=1 TD M-1
280 PRINT M(N);
290 IF N<>M-1 THEN PRINT " x ";
300 NEXT N: PRINT
300 NEXT N: PRINT
310 GD TD 120
320 DATA 2,3,5,7,11,13,17,19,23,29
330 DATA 2,3,5,7,11,13,17,19,23,29
330 DATA 31,37,41,43,47,53,59,61,67
340 DATA 71,73,79,83,89,97,101,103
350 DATA 107,109,113,127,151,137,139
360 DATA 149,151,157,163,167,173,179
370 DATA 181,191,193,197,199,211,223
380 DATA 227,229,233,239,241,251,257
390 DATA 263,269,271,277,281,283,293
400 DATA 307,311,313,317,331,337,347
410 DATA 349,353,359,367,373,379,383
420 DATA 389,397,401
  Listing 1.
```

become specialised, rather than of more general utility. As it stands, it could equally well be used to solve:

'A hundred campers ran short of food, and some of them went out to forage among the local farms. Each brought back the same number of eggs, the total number of eggs being 5459. How many campers stayed behind in camp?

Here, we run into a typical hidden snag. The computer can factorise 5459 and subtract the lesser factor from 100, but the answer could still be wrong, since nothing was said about all the rest of the campers staying in camp. Similarly, a different answer to the club problem could be worked out on the basis that the subscription involved an odd 1/2 p. Subtleties like that are hard enough to detect in manual working, but the computer - being ignorant of the tortuous workings of the human mind - could only pick them out if it was programmed to do so.

Another area in which the computer relies on outside help centres around the significance of the particular numbers used in a

problem. For example:

'A store held in stock 1386 Abdabs, 1092 Booboos, 1001 Clangers, and 1716 Doodads. The price of each item was a whole number of pence, not exceeding 10. What were these prices, if the overall value was £397.42?

The four quantities are the key to the matter. If you examine them carefully, you may see how to program the computer to work out most of the solution. A suggested program will be given next month.

COMPUTER LIMITATIONS

Meanwhile, it will be interesting to consider some of the types of problem that are outside the scope of computer capabilities. One problem that has been a source of annoyance for years is about a series of roads fanning out from a given point, and intersected by two other roads. The solution blithely states that the roads form a 'harmonic pencil', on which basis the solution is simple. For those who have never heard of a harmonic pencil the problem is

virtually insoluble, and the computer is in the same situation.

Some problems can be solved, in a rather laborious manner, by trying various combinations of variables in turn. This can be done by setting up a series of nested FOR loops, with the key calculation in the middle, but that approach is slow, and may not be completely valid unless coincidental values are ruled out.

A better approach may be to use the methods which have been developed over many centuries by campanologists (bellringers, for those without dictionaries). This essentially entails a series of exchanges. For a three-element set the changes might be as shown in Fig. 1. When C comes 'home' to its

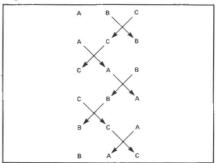


Fig. 1. Exchanging pairs of elements gives all possible combinations.

original position, the sequence is complete. On the other hand, with four elements the sequence is

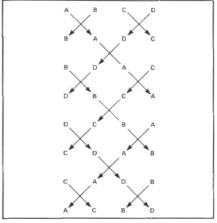


Fig. 2. After one set of changes, a fourelement set has used only eight possible combinations.

shown in Fig. 2. D has come home, but the sequence repeats after only eight of the 24 possible combinations. A variation is required, and this is obtained by exchanging only the right-hand pair, which sets up the next eight changes (see Fig. 3). The variation is repeated to give the final eight.

The method can be extended to more elements, but unfortunately it seems to be impossible to obtain a manual on the more complex methods, though there are no doubt well-thumbed

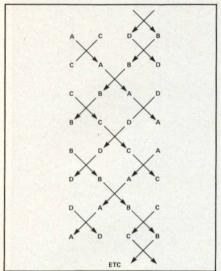


Fig. 3. An asymmetric change gives a second set of eight: repeating this gives the final eight.

copies in remote vicarages where the sound of bells is still tolerated. Otherwise, this type of routine would be useful for certain types of program.

THE INSIGHT STORY

Geometrical problems, which are often based on an obscure Euclidean rule or a subtle fiddle, are likely to beat both the computer and its programmer. There is the classic about a

cylindrical hole, 6" long, through a sphere, which leaves a volume surrounding it that is the same. whatever the size of the sphere. To discover this fact, you need to perform some complex calculus, and if you neither know the fact already nor can work out the mathematics the computer will be unable to help. On the other hand, you scarcely need a computer to work out the volume of a sphere which has a diameter equal to the length of the cylindrical hole, which is the trick of insight required for a simple calculation of the constant volume (Fig. 4).

The truth is that computers still have 'blind spots' in which they can look extremely inept, even if those who program them are able and willing to minimise the limitations. It must always be remembered that the inside of a computer can be isolated from the outside world, and thus is entirely dependent on the facts it contains.

It has been postulated that genuinely intelligent computers will never exist until a method can be devised for making them ask spontaneous relevant questions. The ability to ask pre-arranged questions is not enough, since the programmer might have forgotten something. Unfortunately, it has also been postulated that in order

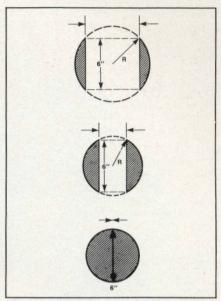


Fig. 4. The hole through the sphere is 6" long. Insight tells us that if the hole has zero width, the volume left is the volume of the sphere. A computer cannot use insight.

to be able to ask intelligent questions spontaneously a computer must first be intelligent, which creates a chicken and egg situation.

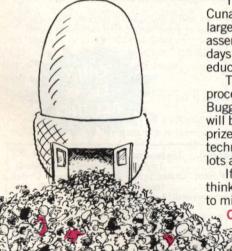
Until a way is found to break this deadlock, we will have to continue to think out in advance the questions which a computer needs to solve a given problem.

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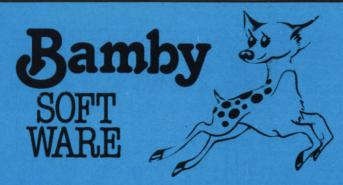
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SHARP * BBC * SHARP * BBC * SHARP * BBC * SHARP *

Simon Goodwin

SOFTWARE PROTECTION



Avast there, me hearties — there's a vast swindle going on. Is the industry fighting a losing battle against the pirates?

hatever your interest in computing you've probably encountered software protection — the techniques used to ensure that only the author or distributor of a program can publish it. This article investigates the schemes, digital and legal, which set out to prevent 'bootlegging' — the illicit copying of software.

There are two aims of software protection. First, it can be a useful way of preventing duplication of programs. Second, it may prevent the owner of a program from altering it. Publishers are especially worried that minor changes might be made to a program, and then it could be sold in competition with the original. Software publishers become very worried when they realise that most of the people who use their programs never paid for the privilege. Once a micro has become established it is quite common for user-groups and

groups of friends to copy original tapes or discs repeatedly. Even in the 'good old days' of mainframe and mini computers programs were often copied unofficially, but this posed little threat to software writers. Users were few and far between, so it was unlikely that a program would travel far. Much software was tailor-made, and of little use to those outside the firm which paid for it.

The microcomputer software market is very different. Programs are general-purpose, and users abound. This has led to a new facet of the computer trade — Software Piracy.

THE SCALE

One PET software house closed down cassette sales two years ago, claiming that there were 10 'bootleg' (unpaid) copies of their programs in existence for every one copy which was paid for. Other publishers have commented that sales drop off sharply about six months after a program is released — by then almost all of the potential buyers know someone who will make them a copy. There is little incentive to buy the program from the distributor.

To some extent the notion of a 10-to-one ratio of bootlegs to legitimate copies is misleading. Many people will take a copy of a program which they would not consider buying. Even so, there can be no doubt that software publishers are losing millions of pounds a year at the expense of those who copy rather than buy.

The most blatant brand of bootlegging was in evidence at the 1982 PCW show. A visitor was seen to be roving the stands, miniature tape-recorder in hand, interrupting and copying the programs from demonstration computers. The layout of the stands — with unattended desks projecting towards the passages — meant that the bootlegger could take copies under

cover of the crowds pressing toward the sales-staff at the other end of the desks. Of course, most people who copy programs without permission are a little more subtle than that.

The size of the bootlegging problem does not seem to be the result of large-scale copying by a few individuals. Letters to American magazines such as Byte and 80 Micro have revealed that most computer users, whether hobbyists or professionals, regularly copy programs which they did not purchase. Contact with individuals, clubs and even shops in the UK confirms that this practice is not confined to America!

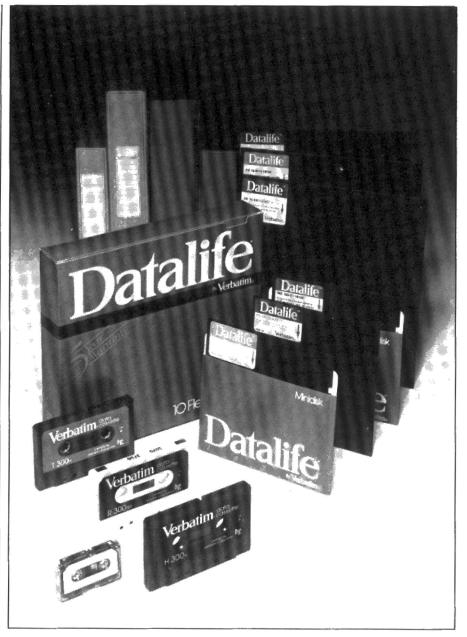
Predictably this issue is a very controversial one. Software publishers argue that their market is being restricted, and that those who write programs are not receiving a just reward for their efforts. Certainly there are a few hobbyists who have libraries of software worth hundreds of pounds, yet they never paid a penny for any of it. Interestingly, many of the most 'valuable' items in their collections often turn out to be business or utility programs which they rarely, if ever, use! Often the bootlegger has little or no documentation for the program — it was copied on the offchance that it might come in useful.

THE LAW

The duplication of programs is probably illegal, since most programs are now sold on the condition that the purchaser does not make a copy. There is no explicit law which says that programs can be copyrighted in the same manner as books or records. The Copyright Act was passed in 1956, when computer systems were still described in the press as 'Electronic Brains' and there were only a few hundred machines throughout the country. The Act does not mention computers at all.

Some firms argue that programs are 'literary work', and hence that existing law protects them. Legal judgements have differed about this principle. Three years ago someone started to sell the 'Micro 'Ace' — a computer with a ROM program almost identical to that of Sinclair's ZX80. Understandably Sinclair took the competitor to court, saying that the copy was illegal. The judge threw out the claim, saying, in principle, that he could not 'read' the ROM and consequently it could not be copyrighted. The Copyright Act says that any document may be 'used' by someone who does not hold the copyright, so long as it is not 'reproduced in any material form'.

Sinclair eventually showed that the physical design of the keyboard



of the Micro Ace duplicated that the ZX80. That duplication was said to be a breach of Sinclair's mechanical patent. The case was eventually settled out of court, and it seems that Sinclair came off better.

A few years ago 'The Softwarehouse' was able to stop a competitor selling copies of a game. The program was called 'Android Nim', and it featured bleeping and buzzing noises as animated robots moved around the screen. A court agreed that the sounds were 'music' in the eyes of the law, and the competitor was forced to stop selling the game, since music can be made copyright without problems.

Another case was brought by a firm called Molimerx (they claim to be named after the Roman word for software, since the Latin word 'molis' means 'soft' and 'merx' means 'ware'!). Molimerx published an American program called 'Level 3 BASIC' for the TRS-80. Kansas City

Systems, another TRS-80 firm, started to sell 'Level 4 BASIC' — a program which more or less duplicated the facilities of 'Level 3', with a few extra options and at least one extra bug!

Kansas claimed that they had legitimately bought the program, but Molimerx demonstrated that most of 'Level 4' program was identical to their 'Level 3', which came first. Kansas City Systems were forced to stop selling 'Level 4'.

TAKING PRECEDENCE

There have been other claims of software stealing, but there is still no clear legislation over computer copyright. Part of the problem is the vast cost of setting a legal precedent. At the time of writing no one has been found guilty of explicitly breaching copyright over software — firms have settled out of court rather than fight a protracted battle

to establish the principle of software copyright. Such a battle would be drawn-out and very expensive for both sides. (Indeed, our own ASP software has had three disputes over The Valley. Two of these were settled out of court, the third is still in progress - Ed.).

Even if copyright law does cover computer programs, it only protects the code, and not the design. Technically any text becomes copyright as soon as it is written, so long as it is 'the original expression of an idea'. There is no need to 'register' the text or to post it to yourself, although that can be useful if you need to prove when you wrote something. The problem is that copyright only protects the words you use, and not their meaning — others can express the same idea in a slightly different way with impunity. You can't stop people copying the ideas in a program by saying that the rules of a game or the facilities of a business package are copyriaht.

If copyright protection is not available then there are still other ways in which a program may be legally protected. Some software houses sell programs under a contract which forbids copying - if the buyer agrees to the contract then the software house is entitled to take legal action if the program is duplicated without permission.

If a new machine or a new industrial process is discovered then it is possible for the inventor to take out a patent. The design is registered and published. If it turns out to be original then the inventor can demand payment from anyone who uses the design. Some firms have tried to patent computer programs, although they have not had much success. Patent law is designed to protect traditional inventors, who have new ideas for gadgets like biros, faster-than-light engines or danger-sensitive sunglasses. It takes a long time about two years - for a patent to be approved, and it costs thousands of pounds. The 1977 Patent Act explicitly says that you can't patent a computer program, but some lawyers argue, confusingly, that you can still patent a gadget than incorporates a computer program, so long as the program is not the only novel part of the device. Unfortunately very few computer programs are original - most programming ideas are simply refinements of previous programs.

Another way to stop people copying a program is to use trade marks. If you think of an original word or phrase you can register it, so that others will need your permission before they use it. In this way the Japanese firm Taito was able to stop other people from calling their games 'Space Invaders', since they registered the phrase as a trade mark. Of course, that didn't stop people producing programs called 'Space Intruders', 'Earth Invaders', 'Star Invaders' and a galaxy of other sound-alike names. It is easier to register a trade mark than a patent, but it still takes a while and you have to pay for a 'search' to ensure that your word or phrase is not already in common use.

SOFTWARE PROTECTION

As arguments over the law ramble on, publishers and programmers have invested large amounts of effort into 'software protection' — tricks designed to make it difficult for users or dishonest dealers to copy programs without permission. Publishers, though, are hampered by the fact that it must still be possible for legitimate users to load and run the programs, so that those who would wish to copy them always have a starting point from which to 'crack' the protection scheme. Unfortunately, avoiding protection is rather an enjoyable occupation, especially to anyone with an interest in logic and programming.

There is no mechanical way to stop people from duplicating taped programs. That is obvious from the

state of the record market, where stickers claiming that 'Home Taping is Killing Music proliferate. The fact of the matter is that there is no feasible way that record companies can stop people from casually taping music. Their only practical action is to sue people who try to make a profit at their expense by issuing bootleg' records — illegal copies. Of course in the software market it is not yet certain that such copies are illegal, although past experience would suggest that they are.

The last people to publicise a mechanical technique for preventing copying were the Beatles' Apple record company. More than a decade ago they claimed that they could stop the copying of records. Apparently their system would work by recording an inaudible ultrasonic whistle on a record. This whistle would interfere with the ultrasonic 'bias' tone of a tape-recorder, producing a 'beat' frequency in the audible range to make copying impossible. Unfortunately the technique is easy to evade (you just filter out the whistle!), and it was never used commercially. Any signal that can be added inaudibly to a record can simply be removed without harm to the music. A similar principle holds with computer-tapes.

The most reliable way to copy computer programs is with the aid of



a computer. Programs are saved as a pattern of 'clicks' on the tape. The timing of the clicks reflects the information stored. Unfortunately almost all computers assign different meanings to the timings, which is why it is usually not possible to load tapes for one brand of computer onto another.

A simple method of software duplication is 'dubbing' recording the sound from one recorder onto another. Normally the recorders must be directly connected for this to work - a microphone and loudspeaker introduce too much distortion, and computer-tapes are quite exacting. Up to a certain level of interference they will reject misleading signals, but beyond that point a tape usually becomes completely unreadable. One extra click on a computer recording can make nonsense of everything that follows. There is consequently a definite limit to the number of times a computer program can be dubbed before the copy becomes unreadable. At each stage the existing hum and noise on the tape is duplicated, and distortion is added. The number of 'generations' of copying possible varies depending upon the type of computer and the machinery used to make the copy, but a third or fourth generation dub of a program is usually useless. However, there is an alternative to tape-to-tape dubbing.

Once the tape-recording pattern or 'protocol' of a machine is known it is generally quite simple to imitate it, using a machine-code routine which will load absolutely any file which the computer can recognise, one bit at a time, storing the details in memory. Normally files contain 'control information', which specifies where they should be stored, whether they are BASIC or machine-code, and other details. All of this information is ignored by the bootleg loader, which just reads the tape, storing each bit, until the end of the file is reached. The control information has been ignored, so that the program being copied has had no chance to take over the system. Once the entire file has been loaded it may be written out exactly as it was read. This form of 'digital copying' has the advantage that the copy is as good as the original. All the hiss and crackle is filtered out when the tape is loaded, so that the copy is in 'first generation' form straight from the computer.

If the 'original' was itself a second generation copy, the new version may actually be better quality. This technique is the most reliable way to duplicate programs—and it is the only way to copy discs, since it is not possible to

directly connect two disc drives and dub between them.

The software protection of disc programs is a fascinating and technical issue. In principle, a disc drive works just like a tape, recording clicks onto magnetic material. Programs are recorded in the form of circular (not spiral) 'tracks' on a disc of magnetic material. The disc is spun whenever the computer tries to read it. The computer is able to move a 'head' similar to the cartridge of a record player, so that the head hangs above any track. Once the head is positioned it is able to pick up the clicks recorded on the track.

Disc software protection involves devious things like missing out tracks or putting them in places where they aren't expected. Discs are normally divided into 'sectors', like slices of cake. Special 'formatting' clicks on the disc mark the start and end of sectors. Protected discs often have missing or oddly-spaced sectors. It is conventional for tracks and sectors to be numbered — protected discs often use odd numbering schemes.

The aim is to stop the copier from working out where the data starts and finishes. The most devious disc-copying programs take a long time to run, since they must make a very exact copy, duplicating everything that could possibly be data, however odd its form, and

making sure that the relationship between all of the clicks is maintained

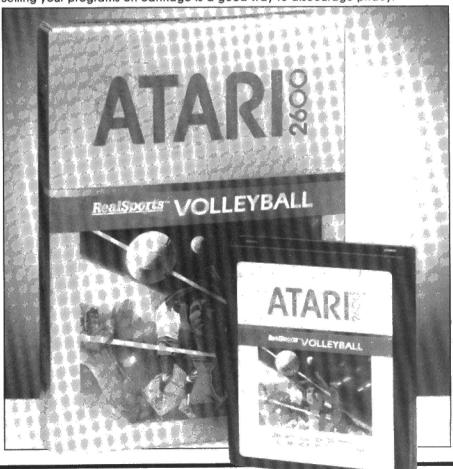
New tricks are constantly discovered by publishers. Just as persistently users work out how to 'crack' them. This represents a tremendous cost to the publisher—sometimes as much as the cost of writing the program itself.

PIRATES IN CHAINS

Bootleg copies of programs generally travel through more than three or four pairs of hands in their lifetime. Within weeks a program can travel hundreds of miles, as it is copied again and again. Sometimes bootleg copies are even offered back to their authors! This almost unending copying leads to a chain letter situation, where first one person makes a couple of copies of a program. Those are copied a few more times, the recipients copy them again, and so on until almost every user had a copy.

It would, perhaps, be interesting to release a progam which caused the computer on which it was run to explode at, say, the tenth or fifteenth load. People would copy it before they found out the snag. Within a few weeks computers would be exploding all over the country. Luckily for those who copy, it is not possible to do this on most computers (although there is

Selling your programs on cartridge is a good way to discourage piracy.



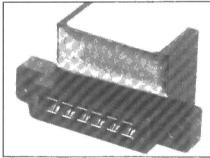
a POKE instruction which will cause early PET machines to catch fire).

In despair, software and music publishers have tried to find a way to force users to pay for their illicit copies. For years there has been a debate over whether or not blank cassettes should be subject to a surcharge. The idea is that the money thus collected could be distributed to record companies and other firms whose recorded work is often bootlegged. The problem is that nobody seems ready to work out a reasonable way of sharing out the spoils. It would be an expensive scheme to implement, and it would be unfair on blind people and those who use cassettes to record their own material.

There are many vested interests involved, including those of recorder manufacturers, tape makers, reel-tape enthusiasts and so on. Originally the scheme was confined to the music business. Recently the arrival of cassette software complicated the issue yet again. It seems unlikely that a tape surcharge will be implemented in Britain.

HARDWARE PROTECTION

Many systems of computer software protection revolve around the use of special hardware such as cartridges or 'dongles'. The idea is that the



This dongle is designed for use with a disc program for the Commodore PCT. It fits onto the cassette port.

average user should be unable to duplicate the attachment which accompanies a program. A dongle is a device which connects to a computer, interacting with software so that a program will not run unless the hard-to-copy dongle is present. This is a useful way to protect programs, although dongles are expensive and consequently they are generally only used to 'protect' costly programs.

Cartridges are another fairly successful method of protecting software. In effect they are dongles and programs all in one, since they contain a complete program in ROM. ROM copiers do exist, but they are expensive and costly to run. On most computers which use cartridges, it is possible to copy the

program out of ROM and save it onto cassette. Later it can be run in RAM instead! A knowledge of electronics is often useful before this trick can be carried out, so that it is not a major source of lost revenue for software traders.

It is important to note that 'bootleg' versions of cartridge software are superficially unattractive since they must be slowly loaded from tape. A cartridge is genuinely easier to use than a tape, since it loads immediately.

SUBTLE PROTECTION

Some software houses ignore software or hardware when they protect their programs. They might ensure that a voluminous manual is needed before the software can be understood and used. Even in the age of the photocopier it is more expensive to duplicate printed material than software. Anyone who has a bootleg copy of the CP/M operating system will be familiar with this argument, although some would claim that Digital Research do not deserve any credit for their discovery!

Complicated documentation has the snag that it leads to 'unfriendly' software. Many good programs have extensive 'menus' or 'help' facilities. These must be omitted if a publisher wants to prevent bootlegging, since they reduce the value of the documentation. Some publishers have capitalised upon unfriendly software by publishing cheap books which explain the facilities of best-selling software. Often these books end up being used as 'unofficial' manuals by those with 'unofficial' copies of a program.

In the business market bootlegging is slightly less of a problem, since many customers are unwilling to use a program when they have no right to help from the authors if things go wrong. It is

surprising how many people will telephone to complain of 'bugs' in programs, and then admit that they had no right to be using them they have bootleg copies.

THE RIGHT PRICE

Computer users often complain at the high price of software. To some extent this stems from a lack of understanding of the publishing market, with its costs dominated by distribution, marketing and stock. There is an old publishing rule which says that, if you want to stay in business, the material cost of a publication should never exceed an eighth of the sale price. Even when this is considered, it is obvious that some publishers are raking in more money than this rule of thumb would suggest.

There is a circular argument which states that high prices must be maintained since most people never pay for their copies of a program. Some low-cost software has, nevertheless, sold very well, especially for newly announced computers. Still, there is a definite stage at which the software market for a given machine drops off. Once users are familiar with its quirks they can copy programs - almost regardless of software protection quite easily. As the number of users grows they meet one another, clubs form, and the spread of copying becomes increasingly wide. A few users become specialist 'crackers', removing the protection from other people's programs as an intellectual exercise

Of course not all computer clubs become pirate gangs, packed with people all ripping off the efforts of others. But a good many do go that way. When members are asked why they do it, the circular reasoning becomes apparent — "Software is too expensive to buy", they say.

STOP PRESS

As this article was being prepared, we received the following press release:

The UK's leading software publisher, Dataview, hopes to have created legal history in the microcomputer industry this week. They have successfully prevented an electronics company, F.A.W. Electronics Ltd, from making a device called Master Key, which had threatened Dataview's software protection system the DTL Protector — which uses the popular security key or dongle. Dataview was the first company to market successfully the now well-known dongle which protects software from illicit copying.

The threat to industry was immediately suspended when Dataview obtained an injunction which prevented F.A.W. Electronics from marketing, selling or even giving away Master Keys.

During the existence of these interim injunctions legal advisers for both sides discussed the situation and agreed to a settlement. "Dataview are on this occasion prepared to accept that F.A.W. Electronics had no intention of deliberately pirating their software, nor any software from other companies using DTI. Protector or any other protection system, but had innocently stumbled into a situation whose ramifications they did not fully appreciate" said Paul Handover, Chairman and Managing Director of Dataview. Both parties have consented to the present injunction continuing perpetually and for all existing Master Keys to be delivered to Dataview.

Dataview's position was based on case law previously not used in the computer industry, which concerned itself with a third party acting in a way which induced a breach of contract between a supplier and their customer. This could well have important ramifications for software houses in the future.

'NOW WIN THE POOLS'

THIS IS MEANT FOR YOU - ESPECIALLY IF YOU USE A SINCLAIR ZX81 or SINCLAIR SPECTRUM COMPUTER, or even ANY COMPUTER.

HAVE YOU EVER HAD THAT DREAM OR EVER WISHED THAT YOU HAD "WON ON THE POOLS" — AT LAST YOU CAN TURN IT INTO REALITY.

THERE IS A SECRET OF "HOW TO WIN ON THE FOOTBALL POOLS" - IT CAN BE DONE. I DISCOVERED THE SECRET A LONG TIME AGO - NOW, FOR THE FIRST TIME I'M PREPARED TO SHARE IT WITH YOU

HOW DOES THIS INTEREST YOU — I HAVE DOCUMENTARY EVIDENCE BY WAY OF POOLS WINNINGS DIVIDEND SLIPS/ CANCELLED CHEQUES, etc, SHOWING MY PRESENT WINS ON THE POOLS AS FOLLOWS:-

First Dividends Second Dividends Third Dividends Fourth Dividends Fifth Dividends Sixth Dividends 2.942 1.952 631

A GRAND TOTAL OF 8,201 (EIGHT THOUSAND, TWO HUNDRED AND ONE DIVIDENDS - so far).

I HOLD THE UNCHALLENGED WORLD'S RECORD FOR POOLS WINS

I AM MAKING THIS VERY SPECIAL, REDUCED PRICE OFFER TO READERS OF COMPUTING TODAY FOR A LIMITED PERIOD ONLY.

Do not let anyone tell you that it is impossible to "WIN ON THE POOLS". method, I HAVE WON REGULARLY for over TWENTY-FIVE YEARS - proof that it is no 'flash-in-the-pan'

I have CHALLENGED THE WORLD with my record of wins and with all the evidence that I possess — NO ONE has ever been able to accept the Challenge - I KNOW NO ONE EVER WILL.

MY SECRET IS NOW PLACED ONTO COMPUTER CASSETTE FOR YOU.

THE METHOD IS THE GREATEST TREBLE CHANCE WINNER IN THE HISTORY OF FOOTBALL POOLS — IT WILL LAST FOREVER — BOTH FOR ENGLISH AND AUSTRALIAN FOOTBALL POOLS, WITH FOUAL SUCCESS

I now intend to give a limited number of people the over 25 years and proving itself on EVERY ONE
OF THOSE TWENTY-FIVE YEARS.

You will have noted details of my personal achievements so far, as given to you above.

GRAND TOTAL of 8,201, ves 8,201 POOLS DIVIDENDS, including 765 FIRST DIVIDENDS.

My Pools Winnings Dividend slips now number so many, that they fill a very large suitcase and will stand as my evidence of all claims in ANY COURT OF LAW IN THE WHOLE WORLD.

Taking just the past 25 years into consideration, I have won ON AVERAGE over 328, (THREE HUNDRED AND TWENTY ~EIGHT) Pools Dividends EVERY YEAR — or — AN AVERAGE of over SIX DIVIDENDS EVERY WEEK for TWENTY-FIVE YEARS.

You have my absolute Guarantee of the complete authenticity of every claim, cheque, document, letter, etc. contained herein.

I do have losing weeks, but ON AVERAGE my winnings show over SIX DIVIDENDS EVERY WEEK for the past 25 years.

I know that you are now urterly flabbergasted, it always happens to everyone with whom I come into contact. Please just sit back and imagine for a moment my FIRST DIVIDEND wins alone — they now number 765 (seven hundred and sixty-five) and will probably be even more by the time this advertisement appears in print.

I AM NUMBER ONE IN THE WORLD AND NO ONE DISPUTES IT.

For as long as I continue to enter the Football Pools my wins will continue. I have already said, they apply, with equal success to both English and Australian Football Seasons.

I intend to release a STRICTLY LIMITED NUMBER of copies of my cassette, (either for Sinclair ZX81 or Sinclair Spectrum) — DO NOT DELAY AND FIND YOU ARE TOO LATE, in which case I would have to refund your money. I am so confident of YOUR success that if do not win at least THREE FIRST TREBLE CHANCE DIVIDENDS in the first 20 weeks of entering, I will completely cancel the balance of the purchase price and you do not have to pay me another penny, at any time, no matter how vast your winnings

I only wish that space would allow me to give you photographs of my winnings slips, cancelled cheques, etc, but it is of course impossible — they now number 8,201 dividends. I have however given JUST A FEW EXTRACTS from ORIGINAL LETTERS I hold from my small Clientele.

I am the Inventor and Sole Proprietor of my method, Registered as EUREKA – ('I have found it'). I am known as The Professor in Pools Circles – I am of the Highest Rank in Forecasting – this is beyond dispute. I am marketing a limited number of Computer Cassettes, under my Registered Company – FOOTBALL ENTERPRISES.

My initial charge for a copy was £75, but for this SPECIAL REDUCED PRICE OFFER I will send you a copy, (for ZX81 or Spectrum) for £20, (twenty pounds) ONLY, plus your Promise to pay me the halance of £55 — ONLY IF YOU WIN AT LEAST THREE FIRST TREBLE CHANCE DIVIDENDS IN YOUR FIRST 20 WEEKS OF ENTERING otherwise you owe me NOTHING FURTHER.

This is surely proof absolute of my supreme and utter confidence in my own abilities and in the capabilities of my discovery. I could easily CHARGE £2,000 per cassette on the evidence I possess, but that would not be fair to everyone, which is what I want to do.

My method is WORLD COPYWRIGHT, any infringement and immediate proceedings will be taken, without prior warning. It is truly ingenious and has stood the test of time

My cassette is simplicity itself to operate and you'll be given FULL DETAILS for weekly calculating. Your entry need not involve you in any large weekly stakes, you can enter for as little as 25p, if you wish.

I charge NO COMMISSION on any of your wins no matter how BIG they may be.

I realised a long time ago, that it was no good sitting down and dreaming about winning the pools, so I burnt the candle at both ends, working late into the night, occasionally RIGHT THROUGH THE NIGHT, I KNEW there was a way, eventually it all paid off and has been doing so ever since.

I am unable to vary my offer to anyone, so please do not request it, as I shall very easily dispose of the cassettes I have prepared and am making available.

IMMEDIATELY I perfected my method I commenced winning right away, (first with just a little £163, the first week I used it), I HAVE NEVER LOOKED BACK SINCE, amongst all those dividends was one for over EIGHT THOUSAND POUNDS for just one eighth of a penny stake.

I will release a copy on cassette, to you, on receipt of the completed order form and your Signature thereon, confirming you will treat it in the STRICTEST CONFIDENCE between us and retain it for your OWN USE ONLY,

If you happen to be the proud owner of a Computer, other than a Sinclair ZX81 or Sinclair Spectrum, you can still purchase a copy of my method, for the same price and program it YOURSELF on to YOUR OWN COMPUTER.

Don't take my word for it, read what people write about me and my method:-

I won on Zetters last weekend. It was not a big sum, but all the same it was a very nice J.C., Lancs.

appreciate the straightforward method you adopt, which is such a contrast to the rubbish of misrepresentation which is so common in the Betting World, by unscupulous and self-opinionated charlatans. C.H., Devon

Winnings cheque received today, sincere thanks.

D.N., Devon

I congratulate you on your achievement.

R.R., Wales

I should like to thank you for a most exciting season and look forward to hearing from LC., Hants.

I would like to acknowledge cheque and say how much I appreciate your integrity.

J.M., Scotland

Many thanks for your system, it is all you say and more.

Your wonderful system won me £3,527. I intend to visit London soon and will be able to (Overseas Client), P.M., Kampala, come and see you personally.

Many thanks for trying so hard to please us all, your brother should be thanked also. One of our daughters, WHOSE HUSBAND YOU HELPED ENORMOUSLY, has just phoned, the four of them have just spent a lovely holiday in Spain. K.R., Isle of Man

I sent in my FIRST entry last week and won 2nd and 3rd dividends, as you will see from the enclosed certificate. One more and I would have collected over £400 for FIRST dividend. Once I've won a fair amount I shall be staking from winnings and at 2p per line, A FIRST DIVIDEND last week at this would have been over £3,000. C.A., Yorks

I am very interested indeed and enclose £20 herewith. I agree to pay you the balance of £55 **ONLY** if I win at least THREE FIRST TREBLE CHANCE DIVIDENDS in my first 20 weeks of entering — otherwise I owe you NOTHING FURTHER at any time — no matter how much money I win. My Signature below

he Managing Director.	Please tick if cassette is for:	
ignature		+
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my Undertaking to retain complete and	absolute confidence about the method	

Football Enterprises, 'Anvon', 9 New Road. Haverfordwest, Pembs.

Sinclair ZX81 (16K) Sinclair Spectrum (48K) Any other Computer

SIDELEI 3



The New ZX Microdrive! Latest software... Latest prices...

The ZX Microdriveand more!

For some time now, the new ZX Microdrive has been the subject of much discussion. Which is only to be expected, when the object of everyone's anticipation is *completely* new to the world of computing.

Microdrive provides highspeed access to truly massive storage. With just one Microdrive, you'll have at least 85K bytes of storage, and the ability to LOAD and SAVE in mere seconds. Yet the ZX Microdrive is about the size of a Spectrum mains adaptor, and costs less than £50!

First stocks are now in.
Microdrives will be released on an order of priority basis.
Spectrum owners who purchased by mail order, direct from us, will be sent full details including how to order, in a series of mailings that begins with the earliest names on our list.

And if you didn't buy by mail order?

Don't worry — for a colour brochure with full information on Microdrives, including how to order, just send us your name and address (use the coupon at the back of this issue of Sinclair Special). But remember, the sooner you send us your name, the sooner you'll get on the list.

Of course, there's much more to Sinclair than Microdrives, as you'll see on these pages. The latest releases of Spectrum and ZX81 software have been amongst the most successful ever. Prices of most established Sinclair products are at their lowest ever. To buy what you want, just use the Order Form.

Until the next issue of Sinclair Special, and more good news ...

Nigel Searle, Managing Director,

Sinclair Research Ltd.

PS: Come and see us — and all that's new at Sinclair — at the PCW Show, Barbican Centre, from Sept 28th to Oct. 2nd. We'll be pleased to see you!

ZX Microdrive System preview!



ZX MICRODRIVE

At least 85K bytes storage, loads a typical 48K program in as little as 9 seconds: £49.95.



ZX MICRODRIVE CARTRIDGE

Compact, erasable, revolutionary. Complete with its own storage sleeve. Contains up to 50 files, with a typical access time of 3.5 seconds: £4.95.



ZX INTERFACE 1

Necessary for sending and receiving data from ZX Microdrive. Includes RS232 interface, enables creation of local area network of 2 to 64 Spectrums. Attaches to the underside of your Spectrum. Purchased with ZX Microdrive, just £29.95. As separate item, £49.95.



Six new ways to make more of your Spectrum

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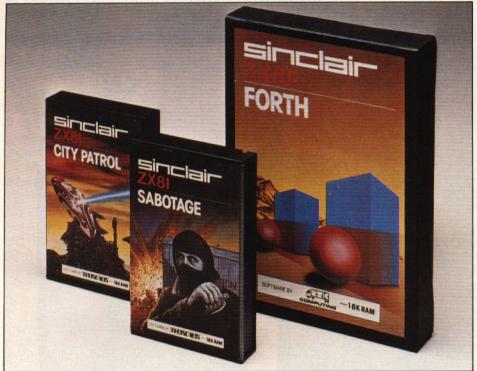
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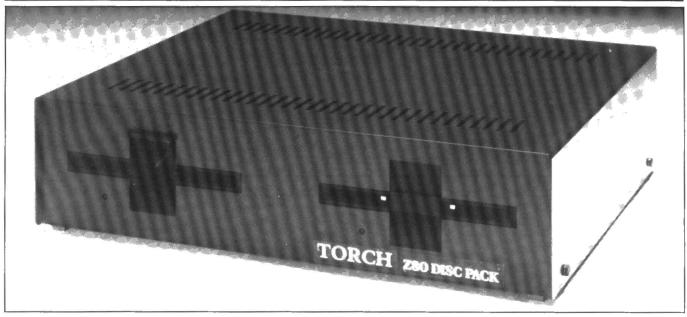
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DISCUSSING THE TORCH

CP/M on the Beeb at last? We applied a Torch to our BBC Micro and this is what happened.



he route to discs is not a hard one for the BBC Microcom-puter owner; the BBC's DFS interface will cope with many of the commonly available 51/4" drives on the market. This means that if you don't want to part with the £265 for an official BBC 100K disc drive, or £804 for a pair of 400K drives, you can buy one of the many proprietary units and usually be guaranteed of both a financial saving and a product which works just as well. As to whether the BBC's disc operating system, DFS, is as good as it could be, I won't pass judgement! Suffice it to say that the Acorn-designed software leaves a lot to be desired in many respects, but then so do many other commercially available disc operating systems.

How, therefore, can the BBC Microcomputer owner get at a dif-ferent disc operating system? Well, the BBC have been promising a Z80 second processor option to allow access to CP/M ever since the system was first specified, but they have been beaten to the punch by Torch Computers of Cambridge. This company evolved from the partnership of two venture capitalists and the management of Acorn, and was originally set up to produce a business computer system called the Torch, which is partially based around the BBC Microcomputer's main PCB. As part of the deal, the management of Torch would provide the software and the Acorn team would put together the hardware to link a Z80 processor onto the BBC Microcomputer's Tube and thus allow the industry 'standard' DOS, CP/M, to be used.

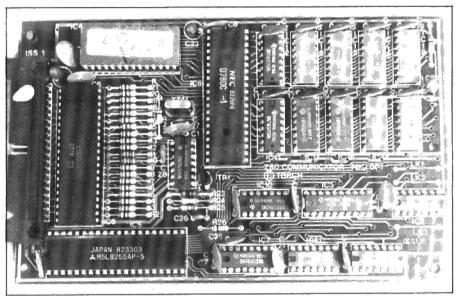
Sadly the partnership dissolved because the Acorn team was too tied up with the BBC project's problems to be able to complete the Z80 card in time, and the Torch team had to go it alone. The Torch computer that eventually resulted has proved to be an excellent product which features high in the opinion of most technical journalists and companies alike. So, how did Torch solve the problem of fitting a Z80 card onto the BBC Microcomputer and what has that got to do with their Disc Pack?

Obviously once Torch had solved the problem for their commercial system, they were free to use exactly the same technique to produce a disc pack for the BBC Microcomputer which would also incorporate a Z80 processor and sufficient memory to allow the CP/M disc operating system to be used as an alternative to the BBC's DFS. The Torch Disc Pack comprises two 400K 51/4" half-height discs in a slimline brown case that fits neatly under the BBC Microcomputer, a Eurocardsized PCB with the Z80 and 64K of RAM that lives inside the BBC Microcomputer's case, and a price tag of £897. As no proper manuals were yet ready, the Disc Pack was supplied with the Torch's manuals, plus a small pile of photocopied sheets detailing the installation procedure and a disc with a number of utility programs. Proper manuals are now available.

CHOP AND CHANGE

Neither of the office BBC Microcomputers were fitted with the DFS interface (a vital requirement even at £110!), so the entire conversion had to be undertaken before any testing of the Disc Pack itself could start. At this point I think I should state that unless you are very confident about installing ICs into your BBC Microcomputer and, in some cases, cutting PCB tracks and making wiring changes then don't attempt this yourself; get your dealer to do it for you. Despite access to a BBC Hardware/Service manual, not generally available to the public, the Torch instructions proved insufficient for me to get everything up and running happily.

The disc interface itself went in easily enough, apart from two minor problems. The first was that the MOS 1.2 (you must have this new MOS — how many more can we expect?) was supplied on a 'butterfly board', and this simply wouldn't fit because of a two-pin connector sticking up from the BBC Microcomputer's PCB. This problem was 'solved' by carefully filing a suitable notch in the butterfly board so that the connector didn't foul the board any more — hardly a satisfactory solution. The second problem is that many of you will have Issue 3 PCBs and these



The Torch Z80 card, which fits inside the BBC Microcomputer.

need a wiring modification. However, when you link pin 9 of IC89 to pin 11 of IC78, you must tirst isolate them from the board by bending the legs out of their sockets and then solder a lead between them. As one of these ICs is the disc controller, a 40-pin chip, it is not a job for the faint-hearted even with the right instructions!

The Acorn DFS and its interface was installed and checked before the Torch Disc Pack was fitted, a move that was to prove wise in view of the events that followed. To start with, our Disc Pack was supplied without its mains lead, even though the packing list was checked off to show it should be there; not a serious problem but frustrating none the less. The problems began when the installation got underway. Following Torch's instruction sheet, the first job was to install the CPN ROM (no, that's not a misprint but Torch's CP/M look-alike DOS) into its correct socket. We now need to remove the BBC Microcomputer's power supply, as all the necessary voltages are provided by the Disc Pack: no problems here except that the instructions say to put the power lead through the Éconet hole. Both logic and the grommet supplied indicate that they really mean the unused Reset hole, and even this has to have the rear panel sticker scraped away to reveal its true size.

LEAD ASTRAY

Power supply connections having been made and checked, the next step was to fit the Z80 card. Here we really started to run into trouble. The card itself is to be mounted onto the underside of the BBC Microcomputer's lid — no problems here — and then the short lead must be connected from the

card to the Tube connector. To start with there is not enough room to get the header plug out of the slot in the casing; you need to partially remove the BBC Microcomputer's PCB to make it big enough, but you can't because the power cable and its grommet foul the back of the board. OK, so you free these and get the cable out ready to mate with the Tube connector. The next problem is that there is no indication of which way round the lead goes; there are no key marks, nothing in the instructions and the diagrams don't help at all. Logic dictates the most sensible way and, surprise surprise, it's wrong! The cable must have a twist in it to help it fold up inside the case and the user has a 50-50 chance of getting it wrong.

With the board installed, hopefully correctly, the Disc Pack cable can be connected to the disc under the BBC Microcomputer and

once again we find that there is a total absence of indication as to which way up the cable should go. The cable goes upside down, at least according to the conventions laid down by the BBC's own disc drive, and you've got a 50-50 chance of getting it right. The correct way is for the cable to be closest to the case and then loop down and back to the drives.

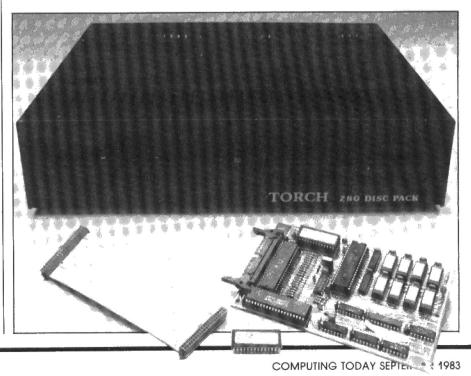
DEATH AND CORRUPTION

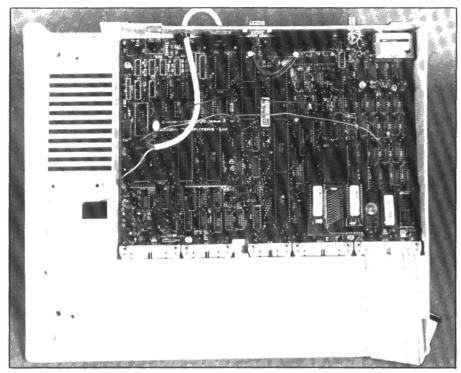
The white power cable is now plugged into the back of the Disc Pack, a suitable monitor is connected and power applied. You can forget using your TV set here as the default display Mode used is Mode 0, and televisions simply cannot handle 80 columns of text. Under normal circumstances you would get a double bleep and the screen would display the message:

TORCH Computer System (v71) Acorn DFS CPN 6A>

to show that all is well and operational.

In our case, nothing. Rapid checks established that it was probable that the disc cable was upside down — the drives were running constantly — and so this cable was reversed. Still nothing. After a few false starts and some time with a multimeter it was established that putting a Torch to our beloved BBC Microcomputer had crisped something, and so we called in the experts. The only recourse was to borrow a spare BBC Microcomputer from Brainstorm, the dealers who had supplied the Disc Pack.





The hole at top left is where the BBC's power supply was: the wires from the white cable are the new power connections. At the lower right of the PCB is the CPN ROM: to its left is the DFS ROM and then the small PCB containing MOS 1.2.

With the replacement machine installed it was then discovered that the master disc supplied, but untouched until that time, was corrupted beyond salvation. The suggested reason for this was that it had slipped from its protective sleeve in transit and happily scraped itself against the manuals and anything else it could get close to. The scratching and buckling of the surface would bear this theory out. With a new disc, a spare BBC Microcomputer and the original Disc Pack the process of reviewing could, at last, begin. The time that this pandemonium and chaos had taken sadly left little time to really evaluate the full potential for the product, but I trust that the following will convey some of its capabilities.

THE SOFTWARE OPTION

The Disc Pack provides the BBC Microcomputer with two 400K disc drives that can be accessed either under Torch's CPN operating system or the BBC's own DFS, provided the ROM is fitted. The system always boots-up in the Torch CPN format, so one of the first commands that you learn is *BASIC which will revert it to the DFS; to get back to CPN is simply a matter of typing *CPN. The facilities available under CPN include FORMAT to prepare blank discs, DUP to copy discs, DIR to display the directory and TYPE to output the contents of a text or documentation file. File names can

be up to eight characters long with an optional three character extension, DOC for documentation, TXT for text and DAT for data being typical examples. Individual files on a disc can be copied with the COPY command, and to make life easy a wildcard option is available where *represents any string of characters and? represents any one character. For example, COPY *.DOC TO *.TXT would copy all files with the DOC extension into files with the same name but a TXT extension. Files may also be RENamed or DELeted as required.

As far as a user of commercially available software is concerned, CPN is completely compatible with Digital Research's CP/M system which opens up a huge library of applications software and languages to the BBC Microcomputer user. Memory is no problem as the Z80 card carries its own 64K of RAM and the CP/M programs live and run here; the BBC Microcomputer is simply used to look after the peripheral devices such as the keyboard, screen and printer.

MANUAL LABOUR

Sadly the trend of inadequate documentation that has befallen many a good product seems to have affected Torch as well. The Disc Pack is currently being supplied with manuals which relate to the Torch computer system. For example, my disc had neither Executives Aid or Cardex on it, which didn't really matter as I wasn't

going to look at the software anyway, but the manuals came as standard. Now, these may be good manuals as they stand — the **Programmers Guide** goes into great detail about the internal operation of CPN and the facilities the software writer could access — but there is very little here that the first time disc user will actually be able to relate to. The **BBC DFS Manual** is poor in many respects but at least you can understand it; these are simply impenetrable to anyone but a systems programmer.

This may seem an odd point to raise but, as far as I can understand it, the purpose of buying a CP/Mcompatible disc system is so that the user will be able to run commercially available software and not worry about how to toggle his cache! What is needed is a new manual that covers the installation procedure thoroughly and correctly (although I do feel that this should not be attempted by the end user at all), and introduces the ideas of using discs as opposed to tape and illustrates the facilities and commands available under CPN. The systems information could then be incorporated into a second manual, which would allow Torch to get rid of all the duplicated material they are forced to include for their computer because they are not allowed to supply the BBC User

CONCLUSIONS

As a piece of hardware the Torch Disc Pack is excellently designed and very well put together. It opens up whole new horizons to both business and personal users of the BBC Microcomputer, but it is badly let down by the lack of user-friendly documentation and a horrendously complicated installation procedure. I would feel a lot happier if I knew that the money you pay for the Disc Pack included fitting by your local dealer and that owner installation was severely frowned on, possibly to the extent of being prevented completely. In operation it proved faultless. There is one cosmetic blemish lurking in the design and that is that the drives do not always manage to eject the discs when the catch is released. I have no idea why as the problem is intermittent, but annoying none the less.

Overall, then, this is a product that turns the BBC Microcomputer from a small home computer system with a restricted memory capacity into a machine with considerable potential. It seems a little sad that Acorn couldn't get their act together in time to do it themselves and let someone

else pip them to the post.



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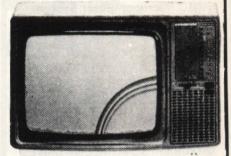
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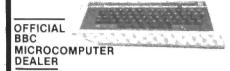
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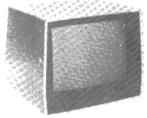
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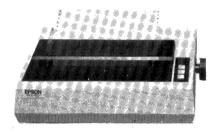
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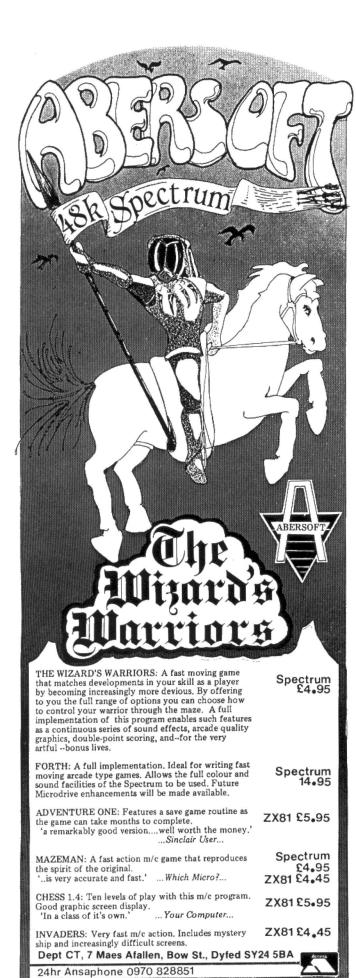
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BACKGAMMON

Here's a classic game brought up to date with a program for the ZX81 that plays against you and obeys all the rules.

ackgammon is one of the more popular and enduring of board games, probably because it doesn't rely solely on blind chance and the throw of the dice, but requires an appreciation of probabilities and the skill to assess the most effective use of your throws. This program puts a simulation of the backgammon board on your TV screen, and allows you to play against the computer. We aren't pretending that this piece of software could wipe the floor with Omar Sharif but it will put up a creditable fight, and can usually be guaranteed to cause you the maximum difficulty if the dice are with it. The performance is especially good when you realise that there isn't enough memory in a 16K ZX81 for a look-ahead probability tree even one turn deep.

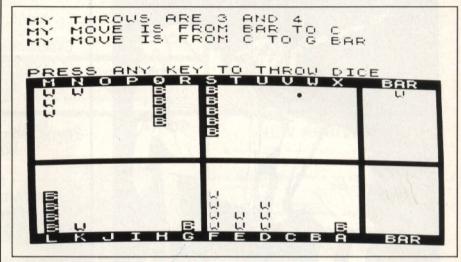
Just to make sure that you don't get tempted into cheating it, the computer checks out everything you enter against the rules of backgammon and rejects invalid moves. The one exception is the rule stating that if a player can only use one of the numbers he has rolled, he must, if possible, use the larger. This was in the copy of rules we obtained, but two backgammon players in the office said they'd never heard of it, so we decided to leave it out. If you play by this rule, it wouldn't require more than about five or six extra lines of code: this is left as an exercise to the reader!

SIMULATION

The working of the program is based on the two position arrays W() and B(), which correspond to the points on the backgammon board. The board consists of 24

Two further elements of each array are used in the game, these being W(31), B(31), W(35) and B(35). The first two hold the number of pieces each player has on the bar, while the second two hold the number of pieces each player has taken off the board at the end of the game.

The computer uses the position arrays to work out its move. For every move that the computer makes, the routine shown in the flowchart of Fig. 2 will be carried out. To give an example, suppose one of the computer's throws is a five. The program will look at each



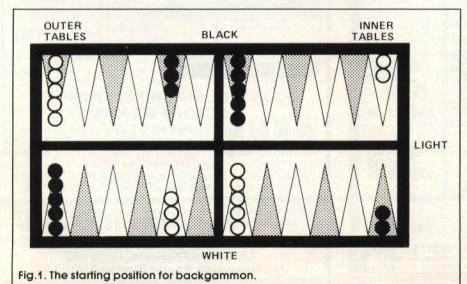
positions, or points, each of which may hold any number of pieces (of the same colour) up to the total number in play. The array elements B(1)-B(24) hold the number of black pieces per position, while the corresponding information for the white player is held in W(1)-W(24). For example, at the start of the game B(1) is set to two, since there are two black pieces at position A on the board. During the course of the game these array elements are constantly changing.

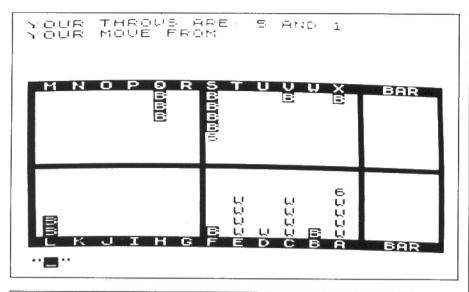
black piece, take the index of its position in the array and add five to it. It can then see the effect of moving the piece five places — whether the move is legal, whether a white piece could be taken, whether a position could be fortified and so on. If the computer is satisfied that the move is a good one, it is carried out.

Things get more complicated when the computer has to check whether a move that you have made is legal. The player's dice throws are stored in a third array, T(), to simplify the checking routines by using FOR-NEXT loops. If the dice throws are not equal, the two numbers are put into T(1) and T(2) in descending order (using T(5) as a temporary store) and the remaining array elements made zero. Otherwise doubles have been thrown, and the first four elements of the array are all made equal, T(5) again ending up as zero.

If a player's move is judged to be valid, the dice throw corresponding to that move must be tagged as 'used' by setting it to an 'impossible' value. We decided that the answer was to use 42!

Since the three arrays completely describe the state of the game with respect to piece positions and dice in play, the





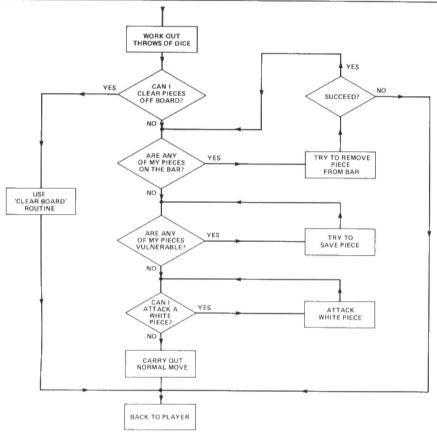


Fig. 2. Flowchart of routine for every move the computer makes.

C E F	VARIABLE C (= M) O (= V) G\$,GG H\$,HH DD F,J,K,L, V,S,Q,T,	FUNCTION Random number used for computer's first throw Random number used for computer's second throw Player's move (from) Player's move (to) Distance of a player's move
	J,X,CC,TT	General purpose loop counters and flags
B V B V B	V() 8() V(31) 8(31) V(35) (()	Position array for white pieces Position array for black pieces White pieces out of play on the bar Black pieces out of play on the bar White pieces moved off the board Black pieces moved off the board Array containing White's dice throws

computer can run through a series of tests involving AND, OR and the arithmetic operators, one test per rule. As an example, the test that a player is genuinely unable to move is made between lines 1370 and 1460. For each unused throw of the dice and each point on the board, line 1400 checks that the corresponding 'destination' point for White really is blocked by Black. Then line 1410 checks that, if White is on the bar, he genuinely cannot move a piece back into play.

An added complication is

An added complication is introduced when White starts to bear off, since it is possible to use a dice throw greater than the distance the piece is moved. Additional logic between lines 690 and 770 takes care of this.

PLAY THE GAME

It is assumed that the user of this program already knows how to play backgammon — it is not a teaching aid. The following instructions are merely to show how to play the game with the ZX81.

The player always plays White and should move in an anticlockwise direction from X to A (see the photographs). When the program is first run, the computer may move first: if this has happened, the computer's dice throws and moves are displayed at the top of the screen. To throw your own dice, press any key, and after eight seconds or so the computer will display the board and your throws. This will happen anyway if the computer has allowed you to move first. (If you would prefer the computer to automatically throw your dice for you after an eight-second pause, delete lines 3190-3210 and change line 3320 to

3220 PAUSE 400

Pressing any key will terminate the pause early, and you can change the delay to suit your needs).

The player will then be asked for his move with the prompt "YOUR MOVE FROM" — you should enter the letter of the point you want to move from, then press NEWLINE. The prompt "TO" then appears, and the destination point is entered in a similar way. If the move is invalid, the computer will say so and repeat the above procedure.

If you can't move you should reply "NO" to the prompt "YOUR MOVE FROM" and the computer will make its next set of moves. If you've made a mistake in entering

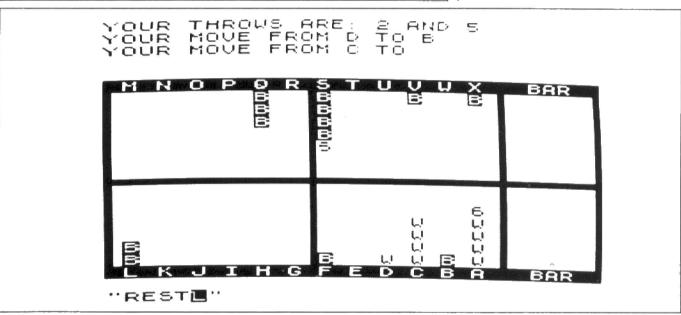
PROGRA	PROGRĀM STRUCTURE			
10-190 200 220-350	Dimension and initialise arrays. Initialise variables. Generate a random number and decide who goes first. Throw random numbers for player's dice and display them. Sort them into descending order for testing later. Check for doubles and amend loop counter and array if necessary.			
Inputting p	layer's moves			
370-540	Display appropriate prompts and accept input. Convert strings to character codes, then subtract offset to put them in the range 1-24. Make preliminary validity checks, and alter GG or HH to appropriate values if "BAR" or "REST" have been input.			
550-610	If White is bearing off, check that move is valid because no pieces are on the bar or off the inner table.			
620-630	Set move distance variable.			
620-680	Test that move distance corresponds to one of the dice throws. If White Isn't bearing off, jump directly to 840 to test flag.			
690-830	Check that, if player is bearing off with a dice throw greater than required, no White pieces are on higher point. Check that a dice throw exists to permit the required move, and set DD to this value ready for the next routine.			
840-910	Check that a dice throw exists to permit the required move, and change the array values to register White's move if it's val.d.			
920-950 960-980	Check for a win by White and print appropriate messages. Stop program Check if any of Black's pieces have been taken and after array if necessary. Loop for next move.			
990 1000-1020	Go to Biack's move Routine to display invalid move.			

the "MOVE FROM" letter, you can cancel the move by typing "NO" in response to the "TO" prompt. The computer will then go back and ask for the move again. Once the computer has accepted a move as valid, you cannot change it.

When moving one of your pieces back into play from the bar, enter "BAR" in response to the first prompt. If you are moving one of your pieces off the board at the end of the game, enter "REST" in response to the prompt "TO".

If you throw a double, you are required to make four sets of moves

Should either you or the computer get more than five pieces on any point, a complication arises because of the restricted height of the ZX81 display. We got round this by replacing the top piece on the point with the number of pieces on the point (the photographs make this clear).



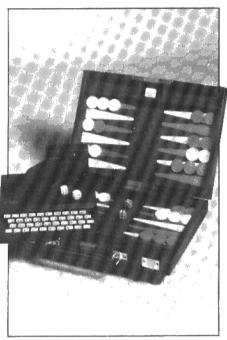
Computer's move			
1030-1070	Subroutine to check whether the computer can start moving its pieces off		
	the board (similar to routine for White above).		
1080-1130,			
1250-1300	Computer decides whether to make an ordinary move or move pieces off		
	the board.		
1140-1160	Remove piece from board with first move.		
1310-1350	Remove piece from board with second move		
1170-1240	Display the move and change the array. Check it Black has wor, and		
	display appropriate messages.		
1360-1460	Entry point to computer's move routine if White has been unable to move		
	This is checked and a jump made to the invalid message routine if		
No. of the last of	necessary. Otherwise fall through.		
1470-1580	Computer's throws calculated and displayed. Loop counter altered if		
	doubles thrown.		
1590	Check to see whether any of computer's pieces are on the bar. If so, go to		
	the bar-clearing routine at line 3120.		
1600-1620	Call subroutine to check it computer can bear off. Go to bearing-off routine		
	at 1080 if so.		
1630	Decide whether to play defensively or not (go to line 1670 if not).		
1640-1660	Check if any pieces are vulnerable. Go to routine at 2010 if any are		
1670-1730	First move (attack white pieces). Check to see if a black piece can move		
	from the point in question. If a white pieces is available for taking on that		
	spot, go to the 'take piece' routine at 2870. An identical routine for the		
	second move is at lines 1870-1930.		

CONVERSIONS

Conversion to other, more sophisticated machines should prove no problem at all. The initial board position could be set up by using READ-DATA statements. CLEAR (line 10) may need a figure after it on some machines. If you use the PAUSE version, the delay could be obtained with a FOR-NEXT loop. RAND need not be used on some machines, but may be found in the form RANDOMIZE on others. CODE is normally found in the form ASC(), and a further complication is introduced by the non-standard ZX81 character set. On a machine using standard ASCII codes, the offset 37 in lines 390, 460, 1190, 2780, 2840, 2920, 3000, 3080, 3270, and 3390 would have to be changed to 64. RND is

usually RND(0) or RND(1).

As far as the screen display goes, much better simulations of the board should be possible on machines like the Dragon 32, BBC and ZX Spectrum due to the higher resolution and colour. If you have a machine which doesn't support PRINT AT or a similar statement, you could adapt the system we used in The Valley with [HOM] and cursor movement strings.



1750-1800	First move (if no white pieces can be attacked). Check if a black piece can be moved legally and do so. An identical routine for the second move is at lines 1940-2000.
2010-2150	Routines for the saving of exposed pieces. Check to see if a white piece can be taken with either the first move (2020), or the second move (2050), or with both moves added together (2070). If a white piece can be taken in any of these ways, the appropriate action is taken. If no white piece is exposed, a check is carried out to see if an ordinary move is possible for the piece (2100 and 2000). If one is found it is implemented.
Drawing the	e board
2160-2240	Plot in frame.
2250-2260	Print top and bottom of frame using inverse video characters.
2270 2600	Display pieces on board using PRINT AT. If more than five pieces are on a
SC 100 19246	point, replace top piece with number of pieces. It either player has pieces on the bar, display them at the side of the board.
2610-2740	If either player has pieces on the bar, display ment at the side of the board.
Bogistoring	Black's Moves
2750 2860	Registering of move if no white piece has been taken (2750-2800 for the first
2,00 2000	move, 28:0-2860 for the second). Moves displayed on screen by lines 2780 and 2840.
2870-3020	fregistering of move if white piece has been taken (2870-2940 for the first move, 2950-3020 for the second). Moves displayed on screen by lines 2920 and 3000. These moves differ from the previous set because W(31) is incremented by one and the array position that the white piece occupied is decremented by one. The player is informed that a piece has been taken by the message "BAR".
3030-3110	This routine is used if the computer has used both its throws together to take a white piece.
3120-3150	If the computer has a piece or pieces on the bar, this routine decides the printoul format to be used. Line 3250 is chosen for the first move, line 3370 for the second. It the computer is unable to move, line 3150 ensures that the appropriate message is printed once only.
3160	It the computer has thrown a double, this line sends the computer back to the beginning of the movement routine to make its second two moves.
3170	Displays the board with the new moves on it.
3190-3240	Waits for the player to press a key before continuing with the next throw of
	the diree. May be altered to a PAUSE statement for automatic play.
3250 3480	Register moves if the computer has brought a piece back into play from the bar (3250-3360 for the first move, 3370-3480 for the second). If a white piece has been taken too, the routines at 3330 and 3450 are called
	res

```
G$="BAR" THEN LET GG=31
NT G$;" TO ";
Listing 1. The ZX Spectrum version of backgammon.
                                                                                                                 410
                                                                                                                            PRINT G$;" TO ";
INPUT H$
IF H$="NO" THEN PRINT AT L;
                                                                                                                420
430
                 CLEAR
                 LET
RAND
                             V=0
         30
         40
                                                                                                                450
                                                                                                                           IF H$="NO" THEN GOTO 370
LET HH=CODE H$-37
PRINT H$
IF G$="REST" THEN GOTO 1000
IF H$="BAR" THEN GOTO 1000
IF G$=H$ THEN GOTO 1000
IF U(31)>0 AND GG<>31 THEN
                 LET
                             C=0
CC=0
T(5)
D=0
         50
60
70
                                                                                                                460
                                                                                                                489
490
500
         80
90
                              M$="MY MOVE IS FROM
                 DIM
                             B(35)
B(19) = 5
B(17) = 3
B(12) = 5
B(1) = 2
                                                                                                                           HND GG > 31 THEN

IF B (HH) > 1 AND H$ <> "REST" T

OTO 1000

IF U (GG) -1 <0 THEN GOTO 1000

IF H$ = "REST" THEN LET HH = 35

LET 0 = 0

IF HH (> 35 THEN
       100
       110
                                                                                                                 510
                                                                                                                        IP B
GOTO
                                                                                                             COTO
                                                                                                                 520
       130
                                                                                                             HEN (
  140 LET B(1) =2
150 DIM U(35)
160 LET U(24) =2
170 LET U(13) =5
180 LET U(8) =3
190 LET U(6) =5
200 IF INT ((RND*2)+1) =1 THE
DTO 1470
210 GOSUB 2160
220 LET F=2
230 LET F=2
230 LET T(1) = INT ((RND*6)+1)
240 LET T(2) = INT ((RND*6)+1)
250 PRINT AT 0,0; "YOUR THROW
RE: ";T(1);" AND ";T(2)
260 IF T(2)>T(1) THEN LET T(
       140
                                                                                                                           IF HH (>35 THEN GOTO 620
FOR S=7 TO 24
IF U(S)>0 OR U(31)>0 THEN L
                                                                                                                 560
                                                                                                                570
                                      ((RND #2) +1) =1 THEN (:
                                                                                                                 580
                                                                                                                           IF 0=1 THEN LET 5=25
NEXT 5
IF 0=1 THEN GOTO 1000
LET DD=GG-HH
IF GG=31
                                                                                                                      Q = 1
                                                                                                                590
                                                                                                                600
                                                                                                                            LF W=1 THEN GOTO 1000
LET DD=GG-HH
IF GG=31 THEN LET DD=25-HH
LET 0=1
FOR T=1 TO 4
IF DD=T(T) THEN LET 0=0
NEXT T
                                                                                                                510
520
                                                                           THROWS A
                                                                                                                530
                                                                                   T (5) =
                                                                                                                 650
      (2)
270
                                                                                                                660
                                                                                                                            IF DD= (1)

NEXT T

IF HH()35 THEN GOTO 840

LET 0=0

FOR T=1 TO 4

IF T(T)=42 OR T(T)=0 THE
               IF T(5) <>0 THEN LET T(2) =T
                                                                                                                 680
690
      280
                         T(5) \leftrightarrow \emptyset THEN LET T(1) = T
                                                                                                                 700
710
                                                                                                                                                            OR T(T) =0 THEN G
                 LET T(3) =0

LET T(4) =0

LET T(5) =0

GOSUB 2160

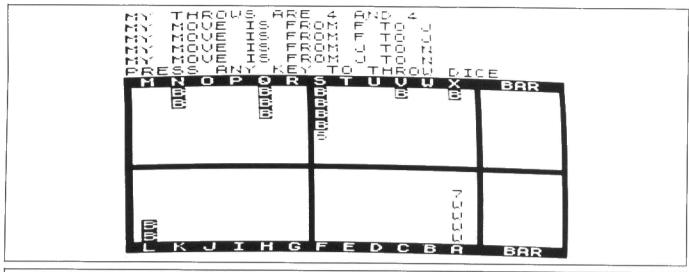
IF T(1) =T(2) THEN LET F=4

IF F=4 THEN LET T(3) =T(1)

IF F=4 THEN LET T(4) =T(1)

FOR L=1 TO F

PRINT AT L,0; "YOUR MOVE FRO
       290
                                                                                                                         760
                                                                                                              OTO
                                                                                                                720
730
ET
740
750
760
                                                                                                                                     3 = GG + 1 TO 5
GG (T (T) AND W (5) > 8 THEN
       310
       320
330
                                                                                                                         0=1
IF
                                                                                                                          0=1
IF GG=T(T) THEN LET 0=0
NEXT 5
NEXT T
IF 0=1 THEN GOTO 1000
LET DD=0
FOR T=1 TO 4
IF T(T)=42 OR T(T)=0 THEN G
       340
      350
360
                                                                                                                 770
780
790
      ദേശ്
                  INPUT G$
LET GG=CODE G$-37
IF G$="NO" THEN GOTO 1360
       390
                                                                                                                 800
                                                                                                              oTo 820
```



```
810
                   IF
                             T(T)>=GG THEN LET DD=T(T)
                1350 GOTO 1170
    NSS
     330
                                                                                                                                   1360
                                                                                                                                                    PRINT
                                                                                                                                  1370
1380
1380
070
                                                                                                                                                    FOR S=1 TO 24
FOR T=1 TO 4
IF T(T)=42 OR T(T)=0 THEN G
    840
     360
             0 IF
                                                                                                                                  1390 1F (()=42 OR (()=6 THEN G
TO 1430
1400 IF B(S) (2 AND U(S+T(T))) 0 A
TO U(31) =0 THEN LET Q=1
1410 IF U(31) >0 AND B(25-T(T)) (2
 OTO
                890
IF DD=T(T) THEN LET T(T)=42
IF T(T)=42 THEN LET T=6
NEXT T
LET W(GG)=W(GG)-1
LET W(HH)=W(HH)+1
IF W(35)=15 THEN PRINT "YOU
     380
     890
                                                                                                                                  1420
1420
1430
                                                                                                                                                    LET
IF 0
                                                                                                                                                               T 0=1
0=1 THEN LET T=5
                                                                                                                                                   NEXT
IF O
     910
                                                                                                                                                               Q=1 THEN LET 5=25
    930 IF W(35)=15 AND B(35)=0 AND
B(31)=0 THEN PRINT "BY A GAMMON
                                                                                                                                                   NEXT S
IF Q=1 THEN GOTO 1000
LET C=INT ((RND *6) +1)
LET X=1
LET M=C
CLS
LET TT=1
LET D=INT ((RND *6) +1)
LET U=D
IF M=V THEN LET X=2
PRINT "MY THROWS ARE ",C;"
                                                                                                                                      450
                                                                                                                                   1450
1470
1480
1480
  940 IF W(35)=15 AND B(35)=0 AND
B(31)>0 THEN PRINT "BY A BACKGA
                                                                                                                                   145000
151000
151500
151555
    MON"
950 IF W(35)=15 THEN STOP
960 IF B(HH)=1 AND HH<>35 THEN
ET B(31)=B(31)+1
970 IF B(HH)=1 THEN LET B(HH)=B
 IND
                                                                                                                                   HND
1560
1570
1580
1590
1600
                                                                                                                                                    FOR U=1 TO X
                                                                                                                                                 | FOR U=1 TO X
| LET C=M
| LET D=U
| IF B(31)>0 THEN GOTO 3120
| LET Q=0
| GOSUB 1030
| IF Q=0 THEN GOTO 1080
| IF INT ((RND*2)+1)=1 THEN G
1670
| FOR N=1 TO 24
| IF B(N)=1 THEN GOTO 2010
| NEXT N
                GOTO 370
FOR 5=1 TO 18
IF B(5)>0 OR B(31)>0 THEN L
 1020
                                                                                                                                   1040
1040 IF B(S) >0 OR B(S1) >0 IMEN L

ET Q=1

1050 IF Q=1 THEN RETURN

1060 NEXT S

1070 RETURN

1080 IF C=0 THEN GOTO 1250

1090 FOR X=19 TO 24

1100 LET N=X

1110 IF X+C(25 AND B(X) >0 THEN G

0SUB 2750

1120 IF C=0 THEN GOTO 1250

1130 NEXT X

1140 FOR X=(24-(C-1)) TO 24

1150 IF B(X) >0 THEN GOTO 1170

1160 NEXT X

1170 LET B(X)=B(X)-1

1180 LET B(35)=B(35)+1

1190 PRINT "I HAVE MOVED "; CHR$

(X+37); " OFF THE BOARD"

1200 IF B(35)=15 THEN PRINT "I U

IN ";

1210 IF B(35)=15 AND U(35)=0 AND

U(31)=0 THEN PRINT "BY A GAMMON
                                                                                                                                                               (T N
C=0 THEN GOTO 1810
$ N=1 TO 24
B(N)=0 THEN NEXT N
N+C>24 THEN NEXT N
U(N)>1 THEN NEXT N
U(N+C)=1 THEN GOSUB 2870
C=0 THEN GOTO 1810
                                                                                                                                                    FOR
IF
IF
                                                                                                                                                     IF
IF
                                                                                                                                                    NEXT
                                                                                                                                                                      N
                                                                                                                                                               (T N

1 N=1 TO 24

B(N)=0 THEN NEXT N

U(N)>1 THEN NEXT N

U(N+C)<2 THEN GOSUB 2750

C=0 THEN GOTO 1810
                                                                                                                                                    FOR
IF
IF
IF
                                                                                                                                                    IF Č=Ø
                                                                                                                                     300
310
                                                                                                                                                   NEXT N
IF D=0 THEN GOTO 3140
GCSUB 1030
IF Q=0 THEN GOTO 1080
LET TT=TT+1
IF TT>1 THEN GOTO 1870
GCTO 1640
FCR N=1 TO 24
IF B(N)=0 THEN NEXT N
IF N+D>24 THEN GOTO 1940
IF W(N)>1 THEN NEXT N
IF W(N+D)=1 THEN GCSUB 2950
IF D=0 THEN GOTO 3140
NEXT N
                                                                                                                                   1520
1530
1540
1550
    1220 IF 8(35) =15 AND
U(31)>0 THEN PRINT
MMON"
                                                            AND W(35) =0 AND
INT "BY A BACKGA
                                                                                                                                     350
370
380
                 IF B(35) =15 THEN GOSUB 2160

IF B(35) =15 THEN STOP

IF D=0 THEN GOTO 3160

FOR X=19 TO 24

LET N=X

IF X+D(25 AND B(X))0 THEN G

2810

IF D=0 THEN GOTO 3160

NEXT X

FOR X=(24-(D-1)) TO 24

IF B(X))0 THEN GOTO 1340

NEXT X

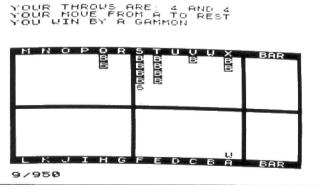
LET D=0
  1230
                                                                                                                                   1890
 1240
 1250
1250
1250
1250
1250
                                                                                                                                   1910
1910
1920
1940
1950
                                                                                                                                                  IF D=0 1...

NEXT N
FOR N=1 TO 24

IF B(N) =0 THEN NEXT N
IF W(N) >1 THEN NEXT N
IF N+D>24 THEN STOP
IF W(N+D) <2 THEN GOSUB 2810
IF D=0 THEN GOTO 3140
                                                                                                                                   950
1970
1980
 1300
 1310
 1330
                                                                                                                                   2000
```

C=0 THEN W(N+C)=1 GOTO 2040 605UB 2870 2010 IF IF 2020 2030 C=Ø THEN D=Ø THEN W(N+D)=1 COTO 2060 GOSUB 2950 GOTO 040 ÎF 050 95**0** 95**0** 97**0** THEN GOTO 1660 C+D) =1 THEN GOSUB 30 W(N+C+D) =1 IF C=0 AND D=0 THEN GOTO 31 080 COTO 2090 THEN C=0 (HEN GOTO C=0 THEN GOTO D=0 THEN GOTO U(N+D)=0 THEN IF IF IF G05UB 2750 1660 2140 100 110 130 GOSUB 2810 0 31 2140 D=@ AND 0=0 GOTO 2140 40 2150 2160 2170 2180 2180 GOTO 1660 FOR N=1 TO 62 PLOT N,15 NEXT N NEXT N FOR N=1 TO 30 PLOT 0,N PLOT 63,N PLOT 50,N PLOT 25,N NEXT N PRINT AT 21,0 2200 2210 2220 2230 2240 O; "O MAN COMMAND THE TAX) FOR K=1 TO 12) IF W(K)=0 AND B(K)=0 THEN 2280 2280 IF W(K)=0 AND B(K)=0 THE 210 2430 2290 IF W(K)>0 THEN GOTO 2370 2300 FOR J=1 TO B(K) 2310 LET S=J 2320 IF S>5 THEN LET S=5 2330 PRINT AT 21-5,25-(K*2);"| 2340 IF J>5 THEN PRINT AT 21-5 2);"**3**" 21-5,2 -(K+2);J 350 NEXT J 360 GOTO 2430 36**0** 37**0** 360 GOTO 2430 370 FOR J=1 TO W(K) 380 LET 5=J 390 IF 5)5 THEN LET 5=5 400 PRINT AT 21-5,25-(K*2);"W" 410 IF J)5 THEN PRINT AT 21-5,2 -(K*2);J 420 NEXT J 430 NEXT K 440 FOR K=13 TO 24 450 IF W(K)=0 AND B(K)=0 THEN G TO 2600 238Ø 239Ø 2400 2410 2420 2440 JF 1 JF 2600 2460 JF 247 FOW (K) >0 THEN GOTO 2540 FOR J=1 TO B(K) LET S=J IF S>5 THEN LET S=5 PRINT AT S+6,((K-13) *2) +1; 2480 2490 2500 IF J>5 THEN PRINT AT 5+6,((
*2)+1;J
NEXT J
GOTO 2600
FOR J=1 TO W(K)
LET S=J
IF S>5 THEN LET S=5
PRINT AT S+6,((K-13)*2)+1; 2510 K-13) 2530 2540 2550 .. 0+6,((K-13) ±2) +1;"

IF J>5 THEN PRINT AT 5+6,((
) ±2) +1;J
NEXT J
NEXT K
IF U(34) --25**60** 25**70** 258**0** K-13) 2590 2600 2610 IF 2620 IF B(31)=0 THEN GOTO 2690 2630 FOR J=1 TO B(31) 2640 IF J<6 THEN PRINT AT 21-J,2 8;"8"



2650 IF J>5 AND J<11 THEN PRINT AT 26-J,29; "B" 2560 IF J>10 THEN PRINT AT 31-J, 27; "B" 2670 NEXT J 2680 IF U(31) =0 THEN RETURN 2690 FOR J=1 TO U(31) 2700 IF J<6 THEN PRINT AT J+6,28; "U" NEXT J IF W(31) =0 THEN RETURN FOR J=1 TO W(31) IF J(6 THEN PRINT AT J+6,28 2710 IF J>5 AND J<11 THEN PRINT AT J+6,28 2710 IF J>5 AND J<11 THEN PRINT AT J+1,29; "U" 2720 IF J>10 THEN PRINT AT J-4,2 7; "W" 2730 NEXT J 2740 RETURN RETURN

IF N+C>24 THEN RETURN

LET 6(N) =6(N) -1

LET 8(N+C) =6(N+C) +1

PRINT M\$; CHR\$ (N+37); " TO

\$ (N+C+37)

LET C=0

RETURN

IF N+D>24 THEN RETURN

LET 8(N) =8(N) -1

LET 8(N+D) =8(N+D) +1

PRINT M\$; CHR\$ (N+37); " TO

\$ (N+D+37)

LET D=0

RETURN

IF N+C>24 THEN RETURN

LET B(N) =8(N) -1 2740 | 2750 | 2760 | 2770 | 2780 | CHR\$ 2790 | (N+37);" TO " 800 28**10** 28**20** 2830 _c40 ;CHR\$ 2850 #ETURN

IF N+C>24 THEN RETURN

LET B(N) =B(N) -1

LET B(N+C) =B(N+C) +1

LET U(31) =U(31) +1

LET U(N+C) =U(N+C) -1

PRINT M\$; CHR\$ (N+37); " TO

\$\frac{1}{2}\$ (N+C+37); " BAR"

LET C=0

\$\frac{1}{2}\$ RETURN 286**0** 287**0** 2880 2890 2900 2910 2920 ; CHR\$ 2930 2940 \$ (N+C+37); " BAR"

LET C=0

RETURN

IF N+D>24 THEN RETURN

LET B(N)=B(N)-1

LET U(31)=U(31)+1

LET U(N+D)=U(N+D)-1

PRINT M\$;CHR\$ (N+37); " TO "

\$ (N+D+37); " BAR"

LET D=0

RETURN

IF N+C+D>24 THEN RETURN

LET B(N)=B(N)-1

LET U(31)=U(31)+1

LET U(31)=U(31)+1

LET U(31)=U(31)+1

PRINT M\$;CHR\$ (N+C+D)-1

PRINT M\$;CHR\$ (N+C+D)-1

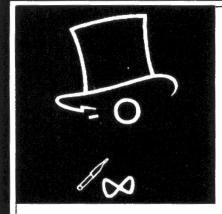
PRINT M\$;CHR\$ (N+37); " TO "

\$ (N+C+D+37)

LET C=0

RETURN

TE U(0) (0 THEN DOTE OF THE COME.) 2950 2960 2970 2980 SOOR 3000 CHR\$ 3030 3040 3050 3060 3070 3080 CHR 3100 3110 3120 3130 3140 LET D=0
RETURN
IF W(C)<2 THEN GOTO 3250
IF W(D)<2 THEN GOTO 3370
IF C>0 AND D>0 AND B(31)
LET CC=CC+1
IF CC=1 THEN PRINT "I HAP
WHABLE TO MOVE" THEN 3150 BEEN "I HAVE 3150 3170 3180 3190 GOSUB 2160 LET CC=0 PRINT AT 5,0;"PRESS ANY KEY THROW DICE" 3200 3210 SLOW IF I IF INKEY\$="" THEN GOTO 3210 FAST 3220 FAS)
CLS
GCTO 220
GCTO 220
LET B(31) =B(31) -1
LET B(C) =B(C) +1
PRINT M\$; "BAR TO "; CHR\$ (C) 3230 3240 3250 3250 3270 3270 3280 3290 IF W(C) =0 THEN PRINT IF W(C) =1 THEN GOSUB 3330 LET C=0 IF B(31) \Q TUTTO C=0 B(31); C 1550 3310 >0 THEN GOTO 3130 GOTO 33**50** 33**40** 33**50** LET W(C) = W(C) -1 LET W(31) = W(31) +1 PRINT " BAR" PRINT DHR RETURN LET B(31) =B(31) ~1 LET B(D) =B(D) +1 PRINT M\$; "BAR TO "; CHR\$ (D+ 33**60** 33**70** 380 33**90** IF $U(D) = \emptyset$ THEN PRINT IF U(D) = 1 THEN GOSUB 3450 LET $D = \emptyset$ IF $B(31) > \emptyset$ THEN GOTO 3140 3400 3410 3420 3430 GOTO 1640 LET W(0) =W(D) -1 LET W(31) =W(31) +1 PRINT " BAR" 3440 3460 3470 3480



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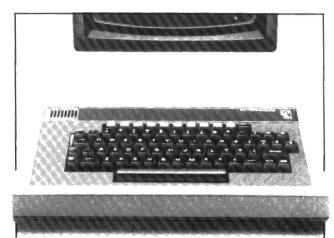
In addition to the disc pack a second processor is supplied. This is a Z-80A with its own 64K RAM card, communicating with the 6502A in the BBC computer through the 'Tube'. Typically the speed of execution of programs under the twin-processor system is increased by up to 50% compared with a conventional single-processor computer. A third processor, the 16 bit 68000, will shortly be available.

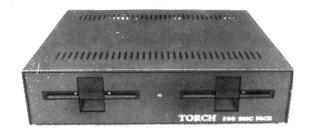
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David Mitchell

CHARACTER GENERATOR

Use a joystick and a little imagination to design your own characters on the Dragon 32.

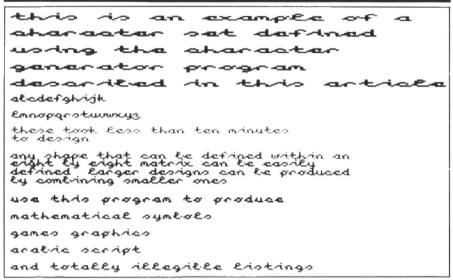


Fig. 1. Examples of a redefined Epson printer character set.

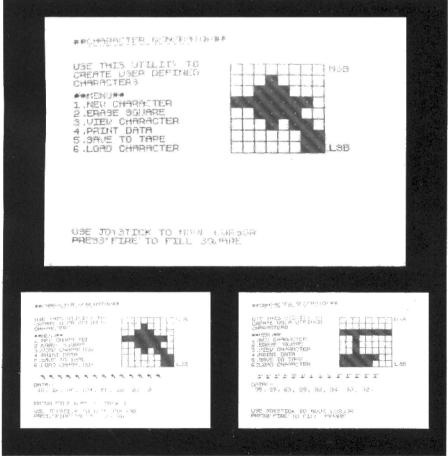


Fig. 2. The front half of the Enterprise has been designed (top). We can display actual size characters and the corresponding data, then SAVE it (below left): then we can design the rear half (bottom right).

ne of the main drawbacks of the Dragon 32 is its lack of user-defined graphics. This can be overcome in any of three different ways. Shapes can be created using the DRAW command and stored in strings; this has the advantage of being fast to use but the design of any but the simplest of shapes is time-consuming, and the resulting strings can be large and use up a lot of memory. The second method is to PSET points on the screen and then save them using the GET command. The resulting array can then be PUT back on the screen at any position. This seems a good idea until you work out that, for an eight by eight character, you may have to specify up to 64 'PSET' points.

By studying the screen memory mapping in PMODE 4, a third and easier method can be used. In this mode, 6, 144 bytes of screen memory are used; this is arranged in 192 rows of 32 bytes. Each byte is composed of eight bits (binary digits), each of which can either be zero or one. The first eight pixels on the high resolution screen correspond to the eight bits of the first memory location; therefore POKEing the value 255 to this byte will have the same effect as PSETing the first eight pixels on the screen (the binary for 255 is 11111111). If we POKE the same location with the value 85 a different pattern will be seen on the screen, this time corresponding to the binary code 01010101 (= 85). So to build up the same eight by eight character as in the previous example, only eight numbers need to be defined.

To define a simple box character try the following program:

10 PMODE4,1:PCLS:SCREENI,1 20 FOR I=1536 TO 1792 STEP 32 30 H4AC X 40 POKE I.X 50 NEXT 50 DATA 255,129,129,129,129,129,255 100 GHU 100

The only problem with this method is the actual design of the shapes and their transfer into decimal values. The following program takes care of the drudgery of converting binary numbers to decimal and allows the rapid design of user-defined graphics.

GENERATION GAME

On running the Character Generator program, a high resolution screen display appears with an eight by eight grid to one side and a menu and instructions on the other. These instructions are on the screen all the time and are supplemented with further prompts when required. A flashing cursor can be moved around the grid using the right joystick; pressing the fire button fills in the selected square. In the event of errors, pressing key '2' will erase the square.

When a character has been created it can be viewed at normal (eight by eight pixel) size by

Variable A\$(65-122)	Function Defines ASCII characters
T\$(1-25)	Stores the strings used to set up the screen display.
X(1-25)	Contains the x co-ordinates for the titles used in the display
Y(1-25)	Contains the y co-ordinates for the titles used in the
	display
B\$	String used to draw the grid
CX,CY	Position of the cursor in the grid
D(1-8)	Data array
K\$	Value of ASCII string to be drawn on the screen
F\$	File name
l *	

Table 1. The functions of the main variables used by the program.

Line Lines 10-890 Lines 1000-1280	Function Sets up the array dimensions and defines the DRAW strings which make up a full ASCII character set. Each string is given the subscript which corresponds to its ASCII value; this makes it simpler to identify them later in the program. This allows the program to mix text and graphics on the high resolution screen, thus avoiding the need to return to the text screen to enter data or print prompts. Although lower case letters can be obtained through this method, it should be remembered that they cannot be used for file names. (By printing text in this way 42 characters per line, and 24 lines per screen can be achieved. This part of the program can be used in other programs requiring the same approach.) Defines all the strings used in the program and their position on the screen, and puts them into arrays for ease of handling. Line 1270 defines the string to draw the grid.
Lines 2000-2999	Sets up the screen, drawing all titles and the grid.
Lines 3000-3060	Performs the actual drawing of strings on the screen. Handles letter and line spacing.
Lines 4000-4040	Scans the keyboard for valid menu selection and directs program flow to the relevant subroutine.
Lines 5000-5999	Clears the grid for the start of a new design and erases any data or previous patterns. Reads the joysticks and calculates the cursor position. It also flashes the cursor and detects the joystick fire button. If the button is pressed, it also performs the PAINTing in of the selected square. This routine also scans the previous one for any other key press.
Lines 6000-6060	Deletes any filled in square by PAINTing it in the background colour.
Lines 7000-7999	Transfers the design in the grid to an eight by eight pixel version, then GETs it and PUTs a row of them across the screen. It also erases any previous designs.
Lines 8000-8090	Tests each square on the grid to see if it is filled in and converts each row into the decimal value of its binary representation. It then converts each value to a string and draws it on the screen using the subroutine at 3000.
Lines 9000-9140	Handles tape output, drawing prompts and allows input of file name, again on the high resolution screen. It also detects file names which are too long and abbreviates them to eight letters.
Lines 10000-10290	Reads files in from tape, then fills in the grid as appropriate. It then returns to the main program to allow editing.

pressing key '3'. This produces a row of identical characters for inspection. If the results are not correct they can be amended by further use of the fire button and key '2', or by pressing key '1' they can be totally erased.

Pressing key '4' at any time causes a row of eight numbers to appear, each corresponding to the binary representation of one row in the grid. These can be noted down for use in other programs or can be saved on tape.

To save characters to tape press key '5'. A screen prompt will request a file name, then tell you to set up the tape recorder. Recording only takes a few seconds and you are then able to start the next character.



Fig. 3. Pressing '1' resets the display, ready for designing a new character.

The facility exists to read data in from a tape for alteration and rerecording; this option is accessed by key '6'. On reading in the data the grid is filled in, and the cursor begins to flash to allow editing.

Extensive use is made of error trapping, and an incorrect entry is usually accompanied by a flashing message and an invitation to try again. Sound is used (in moderation) to verify key entries.

Note that this program runs in the fast mode; if you press 'Break' remember to press the Reset button before attempting any input or output via the cassette.

With very little alteration the program can be used to redefine the character set of the Epson FX-80 printer. The only difference is that the Epson characters are defined in columns rather than rows. The program can be used as it stands to create sprite graphics for users of the 'High Res' cartridge from Compusense.

CONVERSION

It would be simpler to copy the idea and write your own version of this program, rather than to attempt a line-by-line conversion of this program. The implementation on micros which support text and high resolution graphics on the same screen should be a lot less complicated.

Table 2. How the program works

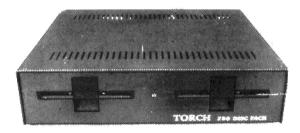
```
### BOOS DEAD FOR THE NO STEP 10

   2000 'set up dcreen
2010 PMDDE4,1:COLORO,5:PCL8:SCREEN1,1
2020 FORI=1 TO 14
2030 Ke=T#(1):X=X(1):Y=Y(1)
```

Listing 1. The complete listing of the Character Generator program.

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ADDRESS

Peter Green

PROCopinion

New editors for old — will the latest one make any more sense than the last? Doubt it.

■ he editor is dead — long live the editor. Actually the long-standing Henry Budgett (it would have been five years with the November 83 issue) has not so much passed away as passed on. Resplendent in the title of Group Software Editor, he will now be organising the programs for ASP Software, ensuring they're bug-free and written to our exacting standards. He'll also be available to the various magazines in our company for help and advice. Finally he'll be riding shotgun on the equipment we're obtaining to allow most, if not all, of the software published by ASP magazines to be listed directly to printer from a working program. This should eliminate typesetting errors and cut down drastically on the number of technical enquiries we receive.

What about me? I've come from across the corridor at Electronics Today International where I was Deputy Editor (I got partial remission of sentence for good behaviour), and hopefully I can not just maintain CT's standards (small s!), but improve them. Changing the name of this column from # File is not one of these improvements — it's just that Henry is rather possessive about the name. Anyway, what's happened lately that's been of interest?

DARKSTAR

The voice on the phone asked if I'd like to attend a press launch. The promise of free food and drink is almost but not quite enough justification for attending these events, so I dutifully asked what was being launched. "A 16-bit personal computer", came the reply. Despite the fact that 16-bit chips are available from almost every semiconductor manufacturer, relatively few of them seem to find their way into personal computers, so along I went.

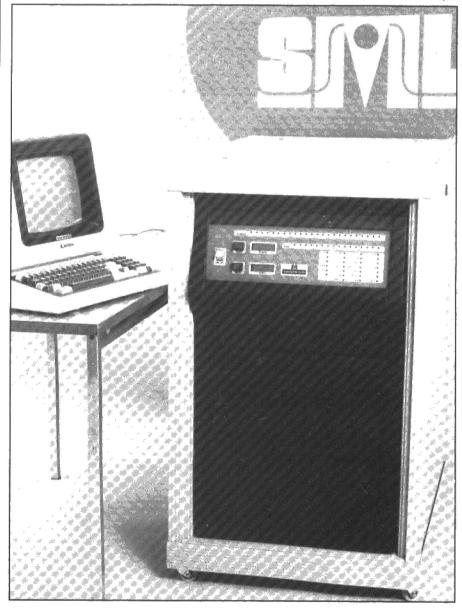
Well, the Darkstar is a 16-bit

Well, the Darkstar is a 16-bit personal computer like the Space Shuttle is a glider. And it establishes an important precedent in the field of R & D, as you'll see later. The machine is a major

implementation of the Motorola 68000 CPU, with up to 6 Mbytes of main memory in the standard 19" rack, 40 to 320 Mbytes of hard disc, up to four 8" floppy discs (1.2 to 4.8 Mbytes of formatted storage), up to four streaming tape drives, a real time clock, and extensive I/O facilities including four serial and two parallel ports, an intelligent cluster terminal controller for eight RS232 lines, and IEEE488 and DEC Unibus interfaces.

The software makes full use of

the internal 32-bit structure of the 68000, with a 32-bit operating system and several high level languages available — FORTRAN, PROLOG, BCPL, Cambridge LISP and Reduce (the Rand Corporation's LISP algebraic processor) available now, and Algol 68, Modula 2 and Pascal coming shortly. Darkstar is a single user, multitasking system, and for networking applications it already has Cambridge ring support, with Ethernet to follow. The basic system with 1/2 Mbyte of memory.



The Darkstar - not exactly your average desktop micro, is it?

one floppy disc, 40 Mb of Winchester disc, four I/O ports and two high level languages costs £11,000 plus VAT: Sirius Microtech Ltd, who market the machine, expect to sell about 50 a year to mathematical and engineering researchers and people working on Expert Systems.

Not yet available, but coming soon and on demonstration at the press launch, are high res colour graphics with light pen and supporting software. The demo I saw was pretty impressive, with the lower half of the screen containing one of those standard 3D 'raindrop on water' ripple plots and the upper half displaying an animated tetrahedral skeleton. The tetrahedron was rotating (flickerfree) about an axis inclined in both the X and Y planes of the VDU screen. (An even more explicit demonstration of the speed of the Darkstar was shown by a calculation, in LISP, of 2^{10,000}. The computer took about 11 seconds to work this out, accurate to the last digit. The number filled about half of the 80-column screen when it was printed out.)

INDUSTRIAL ACTION

The reason why I'm writing about a computer way out of the price range of most people reading this magazine is that it's been designed at the School of Electrical Engineering of the University of Bath. The staff and students there developed it as a research tool because they couldn't find anything like it on the market to do the job they wanted at the price. The charter of the university shows that co-operation with British industry forms one of its roles, and

so SML was set up specifically to exploit the R & D innovations that Bath produces. Furthermore, the operating system of Darkstar, TRIPOS, has been developed and in use at Cambridge University for the last seven years and can therefore be considered stable and reliable, with bugs extremely rare.

The advantages of an arrangement like this are many The hardware is being designed and refined by the end users, so it should end up as an ideal piece of equipment (how many computers can you think of that never seem to have been actually used by the designer?). A similar story applies to the software; it's been in constant use by a large number of lecturers and students for many years (the LISP, also from Cambridge, has been running in this form since about 1975, and is nearly a foolproof implementation), so purchasers aren't going to be plagued by bugs. User-friendliness abounds: one command that the system supports is WHY, which gives a detailed explanation of what you've just done wrong. Ten out of 10, too, for supplying the OS source code.

Another advantage of this type of collaboration is that it helps break down the 'ivory tower' syndrome and prepare students for the 'real world', if close cooperation is required with industry. In the case of Darkstar, where Bath, Cambridge, SML and Motorola have established excellent working relationships, the benefits are obvious.

But most important of all, an arrangement like this allows the vast wealth of talent available among university students to be effectively tapped. In science and

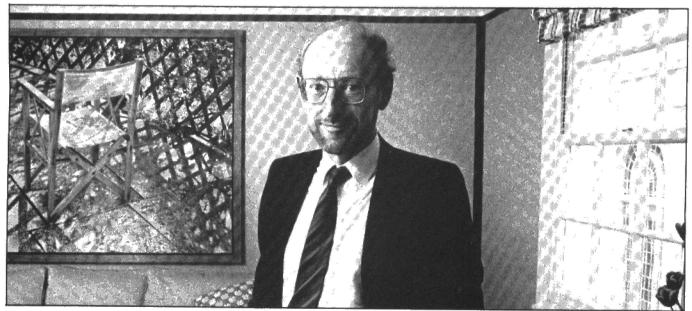
technology, the important work tends to be done before the age of about 25 (look at Einstein - look at Newton). Turning people of this age loose on R & D, at the peak of their enthusiasm, can hardly fail to produce superb work. One of the Bath lecturers was telling me over lunch that his problem is not getting the students to work, it's stopping them. The university is taking the top 90 students in each year from a list of 900 applicants. and the minimum entrance requirement is now two As and a B. That's a helluva research team! Other universities please note: if everyone did this, British industry would leave the world standing.

Any pools winners or research fellows with large grants who are interested in buying Darkstar or talking to SML about future developments can contact them at 15 Alexandra Way, Ashchurch Industrial Estate, Tewkesbury, Gloucestershire GL20 8NB.

Footnote: the software I saw being demonstrated had a nice touch of customisation which showed that the user knew the true role of computers. Instead of the abrupt and sullen 'READY' and 'OK' messages, the terminal was displaying 'I'm still listening, Master' and 'Your will is my command, Master'. Perhaps SML should have taken a leaf out of Oric's book and called their computer Slave!

KNIGHTTIME

To change the subject, the recent Sinclair knighthood has presented we computer journalists with a tricky problem of protocol. Is the correct form of address Uncle, Sir Clive, or Sir Uncle Clive?



Why is this man smilling? Something to do with a regal tap on the shoulder, perhaps \dots

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A.J. Harding

THE TANDY HAT-TRICK

Tandy have been keeping a low profile recently. Suddenly, with a flourish, three new machines!

wo or three years ago Tandy were selling more Model Is than all of the rest of the microcomputer market put together. This leadership lasted for some time but slowly was eroded in the United States by the Apple and later the Apple IIs, together with the IBM, Commodore offerings and others. As the market grew, so Tandy's share, pro rata, decreased. They carried out one or two attempts at improving their position; one suspects, for instance, that the Model 16 was born of panic, since it was a modification of the Model II and, more to the point, released before any software was even a gleam in any author's eye. This, it will be recalled, was followed by the Model 12, about which somewhat similar remarks could be made. In there somewhere, Tandy released their colour computer which was extremely successful in the United States, but did not really get on its feet properly in the United Kingdom due to the multiplicity of low cost colour computers, both domestic and imported, against which it had to compete.

All of these goings on have rather reduced some Tandy watchers to a state of despondency. Others, who recalled the earlier days when Tandy would not even go on record to the effect that there was a single bug in their horrific TRSDOS 0.1, offered up prayers and took faith that Tandy must have something up their corporate

It would seem that such faith has been justified because Tandy are now hitting the market with three new machines, at least one of which is revolutionary.

I think I probably fit within the category of those who had faith and so it was with great pleasure that I was able to take delivery of prerelease versions of these three machines. All of them (with one possible exception) have given me a

great deal of satisfaction.

The three machines in question are the Model 4, the MC10 Micro Colour computer and the Model 100. The latter, of course, has been described in the US press for some weeks. The Model 4 is starting to be reviewed over there, but curiously enough the MC10 seems to be (as of this writing in early June), still under wraps.

MODEL 4

For some reason best known to the hierarchy in Fort Worth, Tandy have broken tradition with the name of this machine; Arabic figures are now used rather than Roman. This seems a pity; one rather got attached to the capital I after the model name, and Model 4 sounds much more mundane!

The Model 4 is an extremely attractive machine physically: it looks somewhat like a white Model III. The additional white keys seem

to be made of some 'super-white' plastic, so the overall appearance is of an ivory case with mostly black keys, but some bright white.

In the United Kingdom all screens will be green; an optional extra in the United States. There are a number of display options depending what mode you are in. The two basic ones are 80 by 24 and 64 by 16, but additionally one can have double width characters, producing 40 by 24 and 32 by 16. The effect of this is rather nice.

Compared to the Model III the keyboard has five extra keys. Three are programmable function keys; but I have not yet worked out how to program them! An addendum to the manual states that F3 will erase the last character, F2 will leave the Insert Edit mode and F1 will pause program execution. None of these seem to function for me and I could not find anywhere in the manual to tell me how to program them for my own applications — apart from the normal way of intercepting the code generated by them.

The two other additional keys are a Control key and a Caps key. These work well and are very welcome. Hitherto, on the Model III, one has had to press the Shift and the zero key to get the effect of the Caps key, and the Shift and down arrow key to get the effect of a Control key.

Various configurations of the machine will be available: probably the usual will be two drives and 64K, while another alternative is 64K and one drive. All drives are 40 track double density. There is also a 16K cassette based system, though I haven't seen one of these.

The only real differences bet-



The Model 4: two machines for the price of one.

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Table 2. Model 4 utilities, drivers and so on.

ween the Model III and the Model 4 are defined by the operating system used. As a tape-based machine does not have a DOS, it is difficult to see how the tape Model 4 will differ from

the tape Model III.

In terms of compatibility, the Model 4 is indeed a giant leap for mankind. Until now, both the software vendor and his customer have had endless difficulties regarding the compatibility of succeeding machines in a particular range (and not just with Tandy machines). The Model 4, however, is a new concept for Tandy. It is, in fact, two machines in the same case. What is even better is that the user does not have to issue any commands, switch any switches or do anything else other than insert an appropriate disc in order to decide which machine is going to be powered up. If you insert a Model III DOS disc into Drive O, then the machine becomes a Model III. It is not a question of compatibility, it *is* a Model III. The Model III ROM is present and any software written for the Model III will operate on the Model 4 in this mode. The machine automatically takes care of the display mode; a Model III disc will cause 64 by 16 mode to be automatically chosen.

This is a very big plus for the machine. In order to run your present Model III applications programs, simply put in your Model III disc operating system and low and behold, you are staring at a Model

Things get a little more complicated when the machine puts on its other hat, that of a Model 4. In the Model 4 mode, you are automatically put into 80 column by 24 line display mode. What happens after that depends entirely on what you wish to do, for the machine is 'blank': it contains no interpretive BASIC. Hence it can run CP/M, and Tandy will be issuing their own improved CP/M 3 shortly, written for them by Digital Research. What comes with the machine is a disc operating system which Tandy call TRSDOS 6.0. It is in fact LDOS 6.0, written by Logical Systems and licensed to Tandy.

Another difference between the Model III and the Model 4 modes is the speed at which the processor runs. To retain compatibility with Model III software, the clock must run in the Model III mode at a speed of 2 MHz. In the Model 4 mode, however, the speed is doubled to

DISC OPERATING SYSTEMS AND BASIC

In Model III mode the question of DOS is up to the user. As far as I know, all major DOSs available for the Model III will operate without any changes or trouble. I personally tried TRSDOS 1.3, LDOS 5.1.3, DOSPLUS 3.3 and MULTIDOS. I did not notice any difference at all over the Model III.

The TRSDOS or LDOS 6.0 is, essentially, a RAM-based LDOS 5.1.3. Some things are lacking, a few things have been added. A complete list of the Library commands available are shown in Table 1. Utilities, filters, drivers and languages are shown in Table 2.

Present LDOS owners will recognise the majority of the contents of these tables. Some need individual mention, for both good and bad reasons. On the asset side is the inclusion, without extra charge, of MEMDISK: a driver controller which enables the creation in RAM of a 'disc drive'. In the Model III version (which is not supplied on the Model 4) it finds most of its users amongst those who have single drives. By remaining in DOS (in other words not calling BASIC), guite a reasonably sized drive can be constructed. This makes single disc operations much more convenient. In TRSDOS 6.0, of course, with the ability to expand the machine up to 128K, MEMDISK really comes into its own, for not only do you get the added conve-

nience of another drive when MEM-DISK is installed, you also get the speed increase of direct access to the contents of your pseudo disc drive. This can produce some really astonishing increases in speed, better even than those obtained by a hard disc drive.

On the minus side, I think we must put the CLICK filter. I suppose I have come across more useless things in a computer at some time or other, but it is hard to remember them. The supposed effect of installing this filter is that every time a key is depressed, a distinct click is heard from the sound output of the machine. Perhaps I have a bad specimen of the hardware, but what comes out of my machine is a rather half-hearted squeak, the effect of which is to make one reach for the oil can rather than anything else.

The COMM utility is very similar to LCOMM in 5.1.3. The TAPE 100 utility establishes transportability with the Model 100

machine, described below.

Turning to the Library commands, the KILL in LDOS 5.1.3 has been replaced by REMOVE. FORMS is somewhat similar to the utility of the same name in the Model II; it enables you to set up various parameters for your printer. SET-COM is also similar to the Model II utility. In this case the RS232 is being set up. SETKI enables the user to change the repeat values of the keyboard driver. A nice Spooler is included. The SYSTEM command has been changed quite considerably: about 12 of the old parameters are retained. SYSGEN. incidentally, has been moved out of the SYSTEM command and been given a command of its own. In other words, to store current system options, one has to type SYSGEN with various parameters rather than SYSTEM (SYSGEN). Existing LDOS users will be happy to hear that the Job Control Language is retained in 6.0.

It would be hard to criticise 6.0. It has retained at least 80% of the most used features of LDOS 5.1.3, and Logical Systems intend to license a number of versions of LDOS 6.0 for various RAM-based machines. The only serious criticism that I have is that 6.0 does not appear to reflect the higher clock speed in the running of the system. Some functions are definitely a lot faster, but some are not.

The most serious criticism that I have of the Model 4 is its BASIC. I think Microsoft are to be criticised most strongly for lagging so far behind in the convenience features of their BASICs. In the last few years, we've all become used to the enhanced convenience features put

into the original Disc BASIC, starting with NEWDOS + and going all the way through to LDOS 5.1.3. I am heartily disappointed that this BASIC has effectively gone back to square one. Indeed, Microsoft seem to have set out to design this particular dialect of BASIC by making it as user unfriendly as possible. For a new user the difficulties will not be apparent, but those of you who are used to Microsoft BASIC on the Tandy or Genie machines (especially when the interpreter has been increased by the addition of a disc from a DOS such as BASIC NEWDOS + , NEWDOS 80, LDOS, DOSPLUS and so on), will go through a number of cursing sessions before they get used to this new dialect.

Let me make it clear, the differences are not (with one or two minor exceptions) in the statements and functions; these remain essentially the same. But we have all got used to using E for EDIT and L for LIST, a comma to edit the last line and so on, particularly those of us who are addicted to using the arrow keys to reach the first, last preceding and following lines of a program. Most important of all, unlike all of the prior Microsoft BASICs, this dialect is distinctly unfriendly on the subject of blank spaces. For instance, in all previous versions the command line LIST10 would display line 10, assuming that there is one. On the Model 4 it will give you a Syntax Error. In the program itself GOTO1000 will not work, GOTO 1000 will. The present experienced user is going to get so many error messages that it is perhaps nice that these are carried in the machine — in other words, on the first error a module is not brought in from disc.

There are no CMD conveniences, or rather there are very few. CMD itself has been replaced by SYSTEM, as in the Model II, and it is possible to add some disc operating system commands. Thus SYSTEM "DIR" will work but some other DOS commands will not. Gone are the CMD Break key disablers, debugger entrances and machine language program loading from BASIC. One almost cries for the lack of the CMD "O" sort and the CMD "X" cross reference utility. It is difficult to know why these have been scrapped. In the directory of TRSDOS 6.0 one sees the familiar LDOS BASIC Overlay file number 1, which contains the Renumber utility (which is included) but not the other two overlays to enable the cross reference and sort. One supposes there must be a technical reason for this rather serious omission. On the other hand it seems

reasonable to argue that if the first overlay could be included, why not the other two?

In all of these serious drawbacks there are one or two small pluses. First of all, the command WHILE ... WEND is included. This is a useful function. It is a very similar to the FOR/NEXT loop which, of course, is also included: the difference is that the loop count is checked at the beginning of the loop rather than at the end. One can exchange values of two variables with a SWAP command. The TRON command is still as impossible to use as ever, inevitably covering the screen with line numbers just when one does not need them. Why don't Microsoft keep the line number report on the top line of the screen? The WRITE and WRITE # commands will respectively print data on the display and write data to a sequential file.

A CHAIN command is included, which is definitely an improvement. There are probably one or two other small changes that I have missed but if, as I suspect, most people will not consider the WHILE... WEND of any great importance, then effectively one is trading-off all of the user conveniences to the CHAIN command. I suppose it is a subjective judgement, but in my book that is a very bad deal.

DOCUMENTATION

The documentation is not up to the normal standard of either Tandy or Logical. Probably the biggest omission of the TRSDOS section is the complete lack of information on the Supervisory Calls. I do not wish to criticise the manual too heavily because it is certainly acceptable. However, one is in a permanent state of uncertainty when using it.

It is, of course, a large manual, as indeed it should be for such a machine and it may be that I have missed parts of it or have not used it correctly. I have still to find what to do with those function keys, however!

TO BUY OR NOT TO BUY

The answer to this one depends entirely on whether you have got a Model III already. If you have and you have only a small interest in CP/M, then don't bother. If, on the other hand, you are thinking of buying a Model III now or in the future, or have some interest in CP/M, then it is a beautiful machine. I personally find the BASIC very disappointing indeed. This is neither the fault of Logical nor Tandy, however, although I suppose one can blame the latter for choosing their vendor.

THE MC10

A review of the MC10 has to be approached rather cautiously because the machine is a very similar size to the ZX Spectrum/Oric type machines. It would be very dangerous to compare the two, for it's my guess that when the MC10 was designed, Tandy had probably never seen any of these smaller English machines.

At any rate, the point must be made that, even though they are of similar size, the MC10 is not intended to be a competitor for the ZX Spectrum or the Oric.

The MC10 is exactly what its first two initials say, name a Micro Colour computer. It is very small, and sells at a very low price. In the United States it is selling at around \$150 to \$160, so I suppose Tandy over here will probably be trying to retail it at just under £100.



The MC10 is not really a Spectrum/Oric competitor.

The first thing that strikes you about the MC10 is that, like all of Tandy's equipment, it is very well built. It is nice and solid and made of a good quality plastic. The keyboard is a normal type in the sense that it has real keys - not a membrane keyboard. When pressed, the keys give a satisfying click. The MC10 measures 8¾" long by 7" deep overall. At its highest point it is 2" high off the desk, going down at the front to about 13%".

The keyboard is a standard QWERTY. Sixteen graphics characters can be typed by using the Shift key and there are 38 single key entries via the Control key for the most commonly used BÁSIC commands. The Control key is also used for the four arrow keys. There are two outstanding criticisms to be made of the keyboard layout. The first is that there is only one Shift control and unfortunately it has been put on the right hand side of the keyboard. It is my experience that most people tend to use the left hand key when two Shift keys are included. To make matters worse, what would normally be the second Shift key on the left hand side is actually the Control key. When using the MC10, then, I almost continuously used the Control key thinking it was the Shift. Control sets the single keystroke mode, so when shifting to get the question mark as the abbreviation for the PRINT command, for instance, more often than not I would get the single keystroke command, which happens to be SQR! The other criticism is that, in order to delete the last character, one has to use the left arrow. I am afraid I frequently have to delete the last character or characters and found it something of a chore to have to use the Control key to get the left hand arrow every time. It would have been far better to have made this arrow key accessible without using either the Control or

the Shift key.
The MC10 comes with 4K of RAM. An expansion port at the back of the computer will enable this to be increased. Tandy as yet are not willing to commit themselves on how much. The display is 32 characters wide by 16 lines. Tandy's manual is a little coy about the other specifications of the machine — unfortunately, a memory map is not included so one doesn't really know how much ROM there is. I would guess that it's a 12K ROM. An interesting inclusion is that of an RS232 interface: this is actually for driving a serial

printer.

The MC10 can generate nine colours, namely black, green, yellow, blue, red, buff, cyan, magenta and orange. The default

SQR TAN VAL	ABS CLOAD COS DIM FOR/TO/STEP/NEXT INKEY\$ LEN LOG NEW POKE PRINT@ RESTORE RUN SIN SQR	ASC CLOAD * CSAVE END GOSUB INPUT LET LPRINT ONGOSUB POINT READ RETURN SET SOUND TAN	CHR\$ CLS CSAVE * EXP GOTO INT LIST MEM ON LGOTO PRINT REM RIGHTS SGN STOP	CLEAR CONT DATA UP ARROW IF/THEN LEFT\$ LLIST MID\$ PEEK PRINT TAB RESET RND SKIPF STR\$
-------------	--	--	--	--

background colour is always green. The graphic characters are printed in the various colours by adding numbers to the CHR\$(n) number. Thus, if you are printing character 129 in, say, red, then the statement would be PRINT CHR\$(129+48).

Table 3. MC10 reserved words.

THE LANGUAGE

The BASIC interpreter is pretty well standard Microsoft; unfortunately, it does not contain Edit functions. Indeed, I found this to be one of the most annoying drawbacks of the machine. As will be known, there are two methods of editing on microcomputers; either with a line editor as on all other Tandv machines, or with a screen editor as on Commodore and other microcomputers. The MC10 does not contain either. You can backspace with the left hand arrow and this erases the last character. There is also a command for line deletion, though the purpose of the latter rather escapes me. I suppose you save a keystroke or two but, of course, you can delete a line simply by typing the line's number. Anyway, for what is worth, the line deletion key is reached by pressing the Control key, and so far as I can see that facility plus the left hand arrow is the sum total of the Edit function. Obviously one has to give up quite a lot, when one miniaturises not only the machine but also the price. It seems a pity to have omitted even a rudimentary screen editor.

The reserved words are shown in Table 3. As you can see, it is a generous interpreter. Most of the commands and functions should be familiar. The SKIPF will skip to the end of the next program on a cassette tape or to the end of a specified program. The inclusion of PEEK and POKE is a welcome surprise: a number of restricted interpreters do not include these essential commands for machine language programming. Of particular interest are the commands CLOAD * and CSAVE *. These will load or save numeric data into or from an array, on to cassette.

The SOUND command is nice and simple to use compared to the larger Tandy Colour machine and the Genie Colour. Only two parameters are specified, tone and duration, each being a numeric expression between 1 and 255. Each unit of the duration number is equal to approximately 75 thousandths of a

The great strengths of the MC10 are that Tandy have not gone the route of a membrane keyboard but have miniaturised a full size keyboard; they have not gone the route of cheapening the package, nor the quality of the electronics.

Of course, as the reader has doubtless realised, the great omission is colour and graphics commands. This is really why it is unfair to compare the machine to a ZX Spectrum-like microcomputer. The MC10 does not pretend to be high resolution, nor does it offer any of the extended colour commands of its big brother, the Tandy Colour Computer. It is essentially what it sets out to be, a miniature colour machine with all of the advantages and disadvantages of such a piece of hard-

THE MODEL 100

The Model 100 is a fascinating and, to a large extent, unique offering from Tandy. Its closest competitor is the Epson HX-20: this is hardly a competitor, though, because the 100 has a liquid crystal display some three or tour times bigger than the Epson's.

The 100 is a truly portable machine. It measures 11%" long by 8½" deep and 2" high. It weighs 4 lb and can, therefore, be carried quite comfortably in a reasonably sized brief-case. It has a full-sized QWERTY keyboard and has a very pleasant feel, the keys giving a distinctive click when they are depressed. A number of non-alphanumeric keys are supplied, including Escape, Control and Caps Lock. There are three other special

keys along the bottom row of the keyboard. On the left is GRPH and on the right CODE and NUM.

The Čode key generates toreign language letters and accents. The specimen that I have was shipped from the States; hence I will not go through the forcian letters available because they may well be different on the UK model. The GRPH key generates a set of graphics in conjunction with the Code key. The Numeric key is unique; it converts the U, I and O keys to 4, 5 and 6, the J, K and L keys to 1, 2 and 3, and the M key to 0. In other words, the Numeric key converts a set of nine keys into an imitation numeric pad.

I think I am right in saying that the liquid crystal display is the largest available on a microcomputer - eight lines by 40 characters. Interestingly, the machine supports dot addressable graphics of 64 rows by 240 columns. Very interesting effects can be ob-

tained with this feature.

Apart from the size of the display, however, what attracts me to it is a little dial on the right hand side of the computer. Moving this alters the visual angle of the display electronically, thus not only making it easier to read, but also circumventing the problem one often gets with LCD when it is at a particular angle to the light source.

Between the display and the keyboard is a set of 16 thin keys set out in four groups of four. Twelve of them are special purpose keys, eight of these being programmable. The bank on the extreme right are the four arrow keys and, of course, control the cursor. The four special purpose keys in addition to the user definable ones are Print, Label, Paste and Break. The Print key sends the screen to the printer; Label displays on the bottom line of the screen the functions to which the eight function keys have been defined; Paste is used with the Text Editor.

The normal Centronicscompatible parallel printer port is available, as is an R\$232. Behind a small door in the bottom of the machine is an expansion bus, plus a ROM socket for additional software which Tandy will be issuing

The CPU runs at 2.4 MHz and is, therefore, roughly similar to the Model III. The machine comes in two memory configurations, 8K and 24K RAM: there is a 32K ROM. This, as its size will intimate, contains more than just the BASIC Interpreter.

SOFTWARE/FIRMWARE

What makes the Model 100 unique is not only the large display, but also the software written into the 32K ROM. This consists of a Microsoft Extended BASIC, a limited but easily usable word processor, an appointment scheduler, communications package and address handler. As all of this software was written by Microsoft it is, to a certain extent, interactive. I do not know how much of the ROM is taken up by the inter-

preter: to a large extent it is similar to the interpreters in previous Tandy models, but there are quite a lew new keywords. Some of them, of course, are only of import to the communications package. For instance, one can define a communication interrupt and use the command ONCOMGOSUB. A similar command is available for a modem interrupt and, for that matter, a time interrupt.

I particularly like the simple word processor in firmware. A number of people nowadays, particularly businessmen, carry miniature electronic typewriters around with them. Most of these, of course, include a form of text editor, but the one in the 100 is far better. More to the point, it has a large screen: hence, it is very easy to use the word processor to produce let-

ters and documents.

The Schedule program is essentially a simple data base manager, as to a large extent is the Address program. A nice idea is that RAM is partitioned into RAM files — the maximum is 19 on a full computer. Programs or tiles are called by positioning the cursor over the appropriate name on the screen and then hitting the Enter key. On first power-up the machine shows the programs in memory. For instance, on an 'untouched' machine the screen will come up with BASIC, TEXT, ADDRSS and SCHEDL, and you choose which one to use. This is a very neat way of accessing programs and files.

The manual is up to normal Tandy quality, although it does exhibit the Tandy habit of missing out one or two items of information. However, one can say this about pretty well any microcomputer manual. In view of the environment in which it is supposed to be used, it is very convenient that the manual is spiral bound so that it lays flat on the knee

Surprisingly, the manual does not contain any sort of tuition on BASIC. If the machine really is aimed at the businessman, or as Tandy say "as an executive work station" then a few pages of 'BASIC tuition would surely have a place. Even so, the Model 100 is a super little computer.



The portable Model 100 - a real computer in your briefcase.

Model 4, 16K, cassette-based: £749 Model 4, 64K, one disc drive: £1299 Model 4, 64K, two disc arives: £1499 Model 4, 128K, two disc drives: £1598.95 MC10: Not yet available Model 100, 8K €499 Model 100, 24K £649 All prices include VAT

Table 4. Prices for the new machines.

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Here are descriptions of just a few of the games

HOUSEBREAK: You enter a house at night in an attempt to robit of money and any gold and silver items you can find. Your object is to clean out the house. In the dark you must avoid bumping into the furniture. After an interval of time an alarm will sound and a short while later the lights will be turned on. A vicious dog is then released and you have to use all your skin and cunning to avoid getting bitten as he chases you around the house. Any injuries caused by the dog will slow down your escape. The game is played in real time, has excellent graphics and is very exciting. A new house is generated each time the game is played.

CORRIDORS OF DOOM! A dungeons & dragons type game that is very addictive. You can never win this game by chance. A lot depends on discovering the secrets of just how you have to deal with each individual monster in the game. There is a liquid which will destroy the Werewolf — but which one? How can you tame the giant spider? Will you ever learn the secret of how to defeat the Blood Devil? All of the monsters have treasures for those who are both brave and wise enough to evercome them, but to escape alive you must first cross some very nasty pits. Play it again and again.

AMAZING 3D MAZES Wander through the giant 18x18x18 mazes collecting freasures, you know where they are but how do you get to them? Extra points are awarded for finding the shortest routes. Don't get too frustrated by apparent dead ends.

3D NOUGHTS & CROSSES Played inside a 4x4x4 cube, this is a game for the intellectual. Great graphics It plays a mean game and wins about nine out of every ten games it plays.

TOWERS OF HANOI You will welcome this classical puzzle which is a must for anyone with a computer. The problems difficulty depends on how many class you use. It might only take you a few minutes with four disks, but with all onstant display of Hours; Mins. Socs, so that you know how well or how badly you are doing at any particular stage. If you find you cannot work the problem out! The computer will show you the shortest possible solution.

THE VAULT. A high security vault in Oxford. (The game can be changed to centre around your own home town; has ten doors, each with its own live figure combination. The combination of the nine inner doors are known, but only the manager knows the combination of the outer door Unfortunately the manager has got himself locked in the Vault. It is your job to get him out before all the Oxygen is used up. The computer will give you metaphorical clues to how near you are getting. The time switches which change the combination every so often can prove a problem. This is a create which reflects the time switches the combination every so often can prove a problem. This is a case which really puts your powers of logic

POPULATION SIMULATION This is a game for two players, each becoming the leader of one of the planets Techno. & 'Primo'. It is a battle to survive. Each decade a player must decide various things in governing his planet, he must carefully balance production and technology against consumption and population. He can either negotiate with his opponent or declare war on him. How about sending out an exploration party in search of new wealth. Only the experienced last very long.

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PRINTOUT

Dear Sir

The review of the Camputers Lynx in your June issue, despite being very thorough and a good piece of work, was a trifle unfair towards this micro. In particular, the reviewer says of the standard 48K machine that "There is no question of trading screen resolution for working RAM. The present machine has 16K of working RAM".

In fact, it is possible to use about 32K of RAM for programs, and I enclose one of Level 9's 32K adventure games to prove it.

The extra memory cannot be used for BASIC, but is available to machine-code programs without too much trouble — I suggest that interested owners contact Camputers (and not Level 9, please) for information.

Yours faithfully, Pete Austin, Level 9 Computing

Dear Sir.

I feel that I must comment on your review of the Lynx in the June issue. One major inaccuracy is in the reviewer's description of the memory map. The workspace RAM is not doubled from 16K to 32K as stated. It is quadrupled to 64K by replacing eight 4116 RAMS with 4164 chips and changing a few links (groan!) on the PCB. I have successfully carried out this upgrade, giving myself 38526 bytes free for BASIC. The reason for this number is that 24K is overlayed with the ROMs, and therefore unusable without deselecting them. This in fact is what would be required to implement CP/M — the ROMs are switched out and the DOS is booted up in the 64K of RAM that becomes available. It is therefore not necessary to add a third bank of RAM, as presumed by the reviewer.

I would also like to take issue with your statement that the Lynx does "...not meet the published specification in full." Come off it — what micro does everything that the adverts say? Consider the Oric-1 — the brochure for that machine claims the existence of DOUBLE, FLASH and INVERSE commands, none of which are

actually present on the machine. Then there is the BBC Micro how long did it take Acorn to bring that up to its published specification by the introduction of OS 1.2? However, your reviews of the Oric-1 and BBC (admittedly not written by the same people) failed to mention these facts. In this respect I feel that you have been rather harsh on the Lynx, especially as the Oric-1 and others have more serious bugs in their firmware. Having said this, I must agree with everything you say about documentation and quality control.

Use of a logic probe reveals that the Break key is connected to the INT pin of the Z80A. As the operating system disables interrupts, it is not surprising that Break does nothing. However, executing the assembly language instruction EI results in an interrupt being generated — without Break being pressed. Do I have a dodgy pull-up resistor?

Would anyone interested in forming a national user group for the Lynx; if so please write to me. I will be pleased to write hardware and software articles, write programs and evaluate software contributions. However, I would like others to handle newsletter distribution and general administration.

Your faithfully, C. Cytera, 30 Wellington Drive, Harmans Water, Bracknell, Berkshire RG 12 3NG.

(* Don Thomasson replies: The advertised memory capacity of the Lynx is 192K, which implies three 64K banks. Within this framework, a number of arrangements are possible, including the one stated in the review and the one Mr. Cytera outlines. Whether this arrangement would meet the CP/M requirement would need to be checked. At the time the review was written, the use of a third bank was under active consideration, since that looked like a preferred solution.

It is agreed that few recent computers have met their stated specifications in full. Is there any reason to conceal that fact? Lynx

owners have said that the machine was let off lightly, not treated harshly, but there seemed to be no point in going into every last detail. It is perhaps unfortunate that other machines have been reviewed even more leniently, because that could mislead members of the public, but covering every aspect of performance can take quite a time. The Lynx review involved about three months of study. That seemed worth while, because the concept of the machine is very good. When the implementation is equally sound, the Lynx could be very good indeed.

With regard to the Break key and interrupt, it can only be said that no interrupt mode is set, so the default interrupt mode applies. If an interrupt has been called at any time between a disable and an enable, it will be executed at the end of the instruction following the enable. It is therefore useful to call disable just before enable, clearing any outstanding interrupts *)

Dear Sir.

I have read your review of the Hobbit, and have also used one for about a month. First, Control B and Control C work perfectly all the time. I use the parallel port and Epson FX80. Ikon have replaced the operating manual as they said they would. The new manual is a neat, spiral-bound booklet with a red cover printed on good quality paper. It devotes a page to each * Command, and describes all the error messages (eg Checksum) and what action to take to correct cause of error.

In operation, it is simple to use and very reliable. In the time I have used the Hobbit it has never failed in saving or loading programs or files. It has been used for sequential files, relative files, the updating of files by reading from one file and writing to another. The APPEND instruction works every time; I tried the Append 10 times on one file without any error. I have also used the Append with Wordwise, joining work typed on different occasions.

Because of the ease of
Saving/Loading, my use of the
computer has increased; I now
save everything and anything
knowing that the Hobbit takes care
of finding the program or a space
for a program. With regards to the
loss of memory, Ikon are to
produce a small sideways RAM
module so that no user memory
need be lost for the buffers of the
Hobbit. As for the solid black

metal case of the Hobbit, if you want an ornament you will be disappointed, but if you want a good versatile reliable system you will be satisfied.

Yours faithfully, J. Smithe, Bradford

Dear Sir,

Thank you for your review of the HOBBIT floppy tape system for the BBC. It was very fair, considering the equipment we lent you, but I wonder if I may bring your readers up to date on the current system.

I) The manual with which you were supplied was a provisional one. I enclose a copy of the current manual, which has now been sent out to ALL purchasers of the system. I hope you agree that it is a big improvement on the original. Our feedback from customers has been positive.

2) The current version of the operating system does NOT have the difficulty you mention with control-B and the printer. I have personally tested this out on version 0.1 of the operating system in BASIC and version 1.2 using BASIC. WORDWISE and VIEW.

BASIC, WORDWISE and VIEW.

3) The real time clock is NOT corrupted as you say. It merely stops while the HOBBIT is running. The data line to the cassette has to be toggled at intervals of 160-320 microseconds. To do this it is necessary to disable all internal interrupts. You are correct in saying that this ought to have been pointed out in the manual.

4) The only problem of any consequence which we are having at the moment is a slight incompatibility with the word processor VIEW (WORDWISE functions perfectly). We are publishing a patch which overcomes most of the problems, although LOAD still does not function. This is easily bypassed by using NEW followed by READ. Everything else seems to work when the patch is used. This letter was written using VIEW. We are still working on the problem and hope to come up with a complete solution

5) We hope to release our "ZERO-RAM" option towards the end of June. This provides 4K of RAM paged with the ROM so that you can have a fully operating file system with two drives and three buffers and still keep PAGE at &EOO.

6) You mention possible competition in the form of 3½ " disc drives. It is worth noting that it costs £100 to have the disc

interface fitted, before even thinking about the drive itself. If anyone has a high speed storage system that can be run from a user port then I suggest they contact us. We can offer a very good operating system to drive it.

7) Fitting of the HOBBIT has been simplified. Current ROMs are able to operate at 2 MHz and this removes the need to change any links or cut any leads. There is not much we can do about making it easier to plug a chip in!

I hope that covers most of the little points that you say "niggled" you. As you know in this line of business it is almost impossible to get things right first time. Acorn released the BEEB with bugs in the cassette operating system, Sinclair had bugs in the ZX81, and need I mention Oric-1 or Lynx.

Yours faithfully, L. J. Want, Co-author of the HOBBIT Operating System.

(* Henry Budgett replies: I am saddened to see that your new manual contains no diagrams at all! While the text is, in some cases, an improvement, the lack of any decent illustrations cannot exactly be described as a great step forward in user documentation. The warning to turn the BBC Microcomputer off before fitting the HOS is still missing, a message that should be printed very clearly on the first page!

The comment I passed on the status of the clock being corrupted still stands. If you stop a real-time clock while an HOS command is being processed, the clock will not hold the correct time when that process is finished. Its contents are, therefore, corrupt.

My view on the possibility of attaching 3½" discs was, and still is, that while these are obviously going to be more expensive they do allow access to a 'standard' operating system environment. You do not have to instal the DFS circuitry to attach discs, they can be accessed through any port. Admittedly they will be slower because they cannot perform DMA but they will still operate, given suitable systems software. *)

Dear Sir,

In reply to the difficulty encountered by N.J. Fitten (June 1983) in saving/loading programs from/to the Casio FX-702P, the problem is almost certainly due to the high input impedance presented by the calculator.

Portable cassette recorders are primarily designed to drive loudspeakers of at most a few tens of ohm impedance. The output amplifier of the recorder is usually isolated from a direct connection to the loudspeaker by means of a capacitor which has to have a high value of capacitance to enable low audio frequencies to be reproduced. Invariably, an electrolytic capacitor is used which unfortunately characteristically means a small polarising current flows into whatever is connected to the output. If this happens to be a high input impedance calculator, a DC voltage is produced which can prevent the calculator from distingushing between the high and low states used as digital information.

The cure is to place a resistor between the output and the earth connection, of a value of about 470 ohms, best soldered inside the recorder. I made this modification to my son's FX-502/FA1 cassette recorder combination which now works perfectly. If Mr. Fitten is not able to make this modification himself, a repair shop should do so for a small charge.

Yours faithfully, S. F. Clarke, Chelmsford

Dear Sir.

Just a brief note in objection to your July cover. Thus far most computer firms on all sides have managed to steer clear of sexist, oppressive material. Hopefully you will do the same! If not, then be assured that I am one reader who will stop reading.

Yours faithfully, J. McLae, London N1.

Dear Sir,

I buy Computing Today every month and so far have enjoyed reading a magazine that gives information in interesting, comprehensive articles with humour.

However, I was deeply offended when I saw the cover of the July issue. It is sexist and degrading to women — an aspect of journalism that I had not identified in your magazine until now.

As a teacher of Maths and Computing, how am I to successfully convince girls as well as boys of the importance and relevance of this part of the curriculum? As long as magazines such as yours continue to present girls and women as attractive sexual accessories to technological progress, it's no wonder that girls feel they have no real part to play in it. Don't you feel you have a responsibility to incite interest in, and enthusiasm about, computing in ALL members of society?

> Yours faithfully, Alison McMichael, Shepherds Bush.

Dear Sir,

With regard to the cover of your July, 1983 issue of Computing Today, I feel required to comment on the unsuitable nature of its design. Surely there is a more appropriate and acceptable method of introducing the topic of 16-bit microcomputers than that which was

employed.

The use of a uniformed schoolgirl as focal point on the cover was an unconscionable abuse of the most blatant variety of sexism in advertising. Perhaps the garter, nylon stockings and pointed bra were meant as a joke, to act in counterpoint with the multitude of phallic symbols (unsheathed (!) lipstick, enlarged (!) interface plug and baseball). It may have been the artist's intention to denigrate both sexes; this does not in any way compensate, however, for damage done to women by the representation of young womanhood on the cover. Your readers do not profit by this exploitation of women as sex objects, and you do your magazine incalculable injury by

attitudes.
Yours faithfully,
Dr. K. Sterling,
School of Management,
Leicester Polytechnic.

encouraging an association with

unacceptable and insupportable

(*That makes it unanimous, then — I didn't like the cover either. Or last month's. Unfortunately I joined CT too late to make any changes: I can only apologise for any offence caused and assure readers that it won't happen again — Ed. *)

Dear Sir,

A study of the Osborne I keyboard will reveal that there are some gaps in the ASCII character set, though all may be displayed. A little investigation reveals that the gaps may be filled by using the Control key in unlikely places. The characters I have found are listed below. Delete is particularly useful when using the Osborne as a terminal, as some computers use this rather than backspace to delete the last character on input.

Yours faithfully, A. David, Canada

Key	Char	Hex
~=	`	60
~,	-<	7 B
~ ·	}	7 D
~/	×	7E.
0.6	<t el=""></t>	2F
(This i	is contro)	o 1

Dear Sir,

Many thanks for your article on the Jupiter Ace. It prompted me to buy one and I certainly haven't regretted it. I recommend it to anyone who doesn't know FORTH and would enjoy the stimulating challenge of learning it. By the way, does anyone out there know where I can get more information either about FORTH or about the Ace itself?

Yours faithfully, Andrew Keen, Southampton

Dear Sir.

Owen Bishop's review of the Jupiter Ace (May 1983) was, I thought, well written and fair to the machine. Unfortunately, in his last section he was less than fair to the FORTH community; there is a viable and thriving body of enthusiasts both at the FORTH Interest Group and here at COMSOL. The FIG secretary is Keith Goldie-Morrison at 15 St Albans Mansion, Kensington Court Place, London W8 5QH.

I must also take this opportunity to correct the book title you quoted: the publication by Tom Hogan is actually entitled Discovering FORTH', and I agree it is of indifferent quality. COMSOL, being a major vendor of professional FORTH systems, stocks a few books that we consider to be the best currently available as follows: The Complete FORTH' by J. Winfield, Wiley & Son 1983; low cost, simple; 'Starting FORTH' by L. Brodie, Prentice Hall, 1982; best all-round textbook: Threaded Interpretive Languages' by R. Loeliger, McGraw-Hill, 1981; for the systems

More information is available by calling COMSOL on 09328-65292 or by contacting FIG.

Yours faithfully, N. L. Vine, Director, Computer Solutions Ltd

Dear Sir.

I read D.S. Peckett's article on FORTH with interest, but I was surprised to find no mention of Extended Fig-FORTH from Atari under systems available. Extended Fig-FORTH (APX 20029 on disc) is a full implementation of Standard Fig-FORTH as defined in the Fig-Implementation Guide and follows the 6502 Rev 1.1 sources as supplied by Fig, with additional definitions including double precision words, floating point and Colour/Graphics to take advantage of Atari's extra features.

Additional facilities include SAVE (which allows you to make a self-booting image of FORTH on disc and will include any new definitions you add) and DECOMP (decompile) in Debug. All of this is available for a modest £29.99 on disc and requires 24K RAM.

Yours faithfully, Mike Wilding, Atari International (UK) Ltd, Slough.

Dear Sir.

One small error in the listing on page 33 of your July edition prevents this program from working.

The instruction on line 1370 should be followed by a semi-colon and not a colon as printed.

Yours faithfully, T.I. Pothecary, London SE19.

Dear Sir.

I am the owner of a Sharp MZ-80K, which I have owned now for over a year. Up to that date I have been unable to lay my hands on any REAL adventure programs, for example, the Mysterious Adventures series that you reviewed in the June '83 edition.

Please could you put me in touch with any software houses that could help me tax my brain by submerging me in a dark castle with only a bent nail to help me.

Yours faithfully, Cpl May

Cpl May, BFPO 43

(*If you contact the following software companies and browse through their catalogues, you'll doubtless find something to your taste. Kuma Computers, 11 York Road, Maidenhead, Berks (phone 0628-71778); Sumlock Bondain Ltd, 263 City Road, London EC1.—Ed. *)



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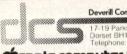
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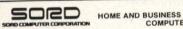


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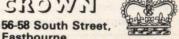
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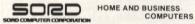
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AD INDEX

ABERSOFT	47
AHKTER	46
AKINTECH	27
AGR	64
ATARI	47
BAMBY	30
BICC VERO	16
CAMB. LEARNING	12
CARDIFF MICROS	27
CARVELLS	26
CASCADE	70
CLWYD PERS. COMPS	13
COMP. CENTRE (HUMBERSIDE)	01
COMPUTER MARKETPLACE	/ 0
CONWAY	29
CROWN	61
CROWN DATABASE	7
DATACLONE	60
DISTRIC	12
DISKING	IBC
DRAGON DUNGEON	64
ELECTRONEQUIP	45
HAPPY MEMORIES	79
INTERTEXT	64
JUNIPER	26
KEYBOARD HIRE	27
KNIGHTS	60
KUMA	16
LEC	79
LEVEL 9	7
LONGMAN	20
MDR (INTERFACES)	47
MICHOSTYLE	13
MICROVALVE	10/11
MOLIMERX	6
POWERTRAN CYBERNETICS	IEC
PRÉMIER PUBLICATIONS	44
RACING & FOOTBALL	36
SCIMITAR	77
SHARDS	E4
SILICA SHOP	ORC
SINCLAIR	27 40
SIR COMPUTERS SPARTAN	54
SPARTAN	70
SPECTRA VIDEO	56
STARMER	60
SUPERSOFT	26
SWANLEY	70
TWICKENHAM	70
WEST COAST PERS.	/0
WEST DEVON ELECS.	11
WORDSWORTH	61
TO THE OWNER OF THE OWNER OWNER OF THE OWNER OWN	61

Wendy J Palmer

CLUB CALL

lot of people go out and buy a microcomputer and then start to learn how to use it with the help of the manuals that accompany the machine and with the aid of other books and magazines. This can be a lonely and frustrating business which is why so many clubs have been formed up and down the country. Going to a club, whether you own a micro or not, is often the best way of learning how to get the most from your new 'toy'. And of course even the more experienced user can gain (and give) a lot. So keep your eye on this regular page for information about clubs in your area and if you don't see one why not start one and let me know about it.

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LIVERPOOL BBC & ATOM GROUP

Contact: Nik Kelly (Secretary) Tel: 051-525 2934

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Because of the interest in microcomputers among RAF personnel and the number of computer clubs at various RAF stations, an Executive Committe of the embryo RAF Computer Association has been formed. The Association has no connection with official Government computing. the objectives relating only to personal recreational computing. It hopes to achieve this through presentations, demonstrations, the promotion of competitions and facilities for the exchange of information, ideas and software. To this end the magazine Computair and its supporting broadsheet will both the published regularly.

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Why not write and let me know about your micro club. Send details such as the place and time of meetings, newsletters, special interests of members and particulars of the machines used, to me at the following address:

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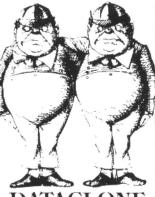
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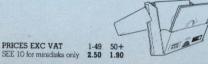


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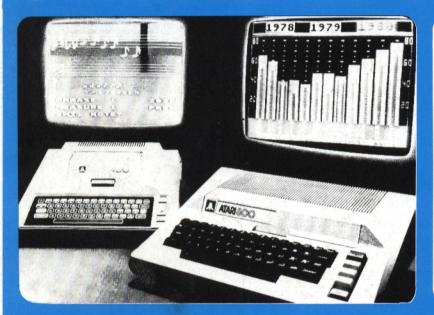
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Jax-O
Jukebox
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Outlaw/Howitzer
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